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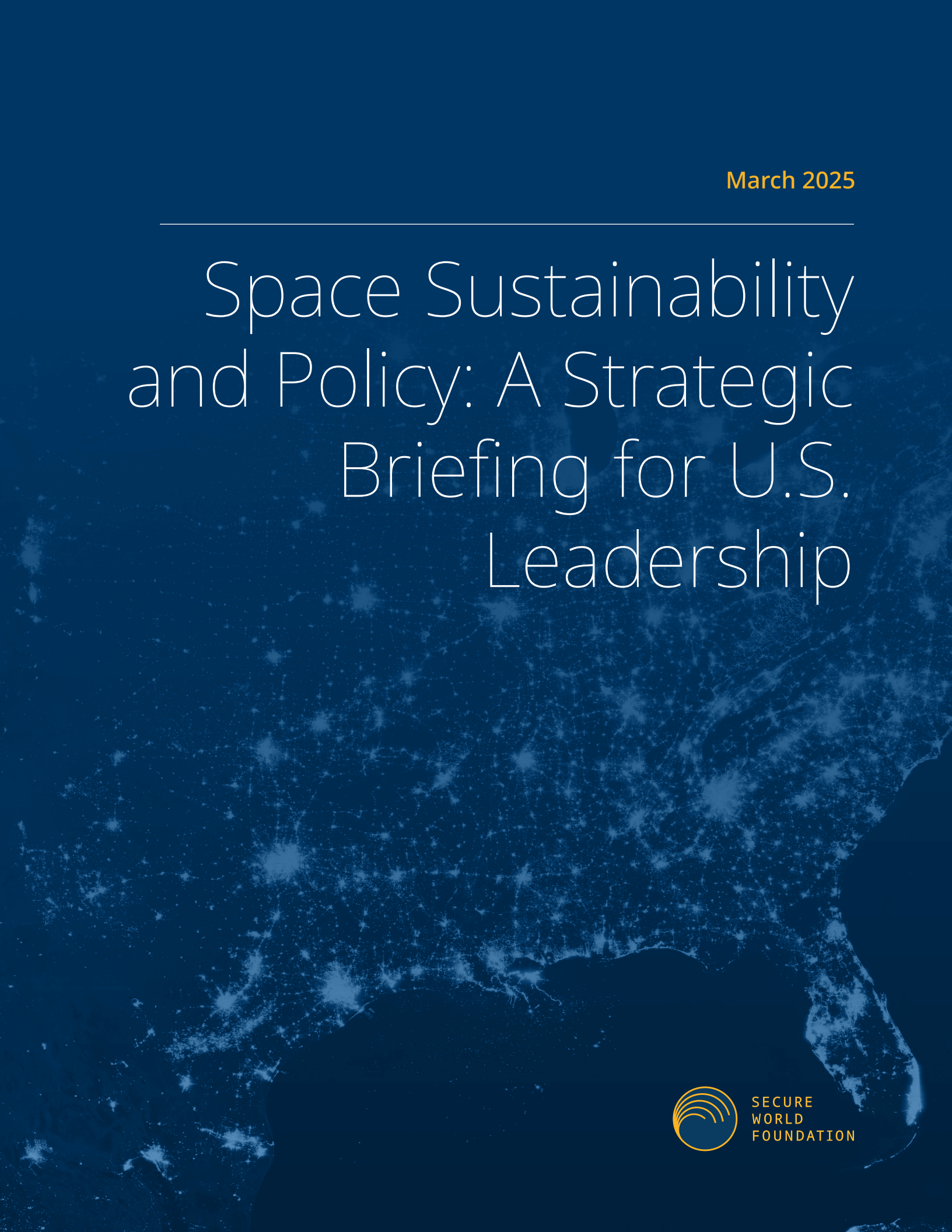
Space Sustainability and Policy: A Strategic Briefing for U.S. Leadership



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About Secure World Foundation

The Secure World Foundation (SWF) is a private operating nonprofit foundation dedicated to promoting the secure, sustainable, and peaceful uses of outer space, ensuring its preservation for future generations. As the only organization devoted entirely to space sustainability, SWF collaborates with international partners in governments, industry, and civil society to foster policies and practices that enhance the protection of the space domain. Recognizing the rapid increase in the number of actors in outer space and the urgent need to promote norms of behavior and best practices to ensure sustainable activities in space, SWF is committed to facilitating dialogue, informing policy decisions, and fostering international cooperation in the peaceful uses of outer space. Through these efforts, SWF strives to ensure that space remains an accessible, safe, and stable operating domain for commercial, military, and civil use by all nations

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SPACE SUSTAINABILITY AND POLICY:

A STRATEGIC BRIEFING FOR U.S. LEADERSHIP

Presented by the Secure World Foundation

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Why Space (and Space Policy) Is Important to America

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Why Space (and Space Policy) Is Important to America

The United States is critically reliant on space capabilities for its economic prosperity and national security. Space capabilities play a significant and growing role in improving the daily lives of Americans and form part of the critical infrastructure of our society. For example, civilian use of the Global Positioning System, which is provided by a constellation of U.S. military satellites 12,000 miles above the Earth, has become a ubiquitous component of daily life. Other government and commercial satellites feed critical data into weather forecasts and models, helping scientists provide improved warnings of severe weather and its impact on communities. Commercial and government satellites serve as critical links in the global telecommunications network, particularly for connecting remote and isolated communities and our military overseas. Space systems underpin and reinforce many of America's national security capabilities and provide the United States and its allies unprecedented advantages in national decision-making, military operations, and homeland security. The United States' freedom to operate in and use space is, therefore a vital national interest.

Since the early 2000s, the global space economy has been growing at a significant rate, driven by increasing private sector involvement in space activities. This growth is expected to continue for the foreseeable future. At the same time, the space domain is also becoming more congested and contested as more countries and other space actors enter this domain. As the world's leading space power, with more civilian and military space assets in orbit than any other country, the United States also plays a central role in shaping the development of norms and rules for safe and peaceful activities in outer space. If space is to remain a domain free for peaceful exploration and use, the United States must play its leading role, not only in the development and application of space capabilities; additionally, it must do so in the development of policy and regulations to shape the development of the global space arena, thereby preserving the stability and security of space for all.

The United States' space successes and their continuing benefits are the result of prescient space policy decisions by a series of U.S. presidential administrations. Those space policy decisions have provided tangible societal benefits that improve the daily lives of millions of American citizens. While nearly every U.S. presidential administration since Eisenhower has issued national space policies, the first Trump administration brought renewed focus and public visibility to space policy.

Many of the first Trump administration's space policy decisions continued long-standing principles and goals that have persisted across multiple administrations, both Republican and Democrat, because they reflect core American values and national interests. First and foremost among these interests is sustained U.S. international leadership to ensure the long-term sustainability, safety, and security of the space domain. This is not done out of pure altruism, but to ensure that the United States can continue to benefit from the use of space over the long term.

The second Trump administration, working together with Congress, federal agencies, and other stakeholders, has the opportunity to continue to place a high priority on space policy and reinforce national space policy decisions that reflect long-standing U.S. principles, which inspire and unify the American public. At the same time, unresolved challenges and problems await the administration. This briefing book serves as a quick, handy, and concise guide to identifying and understanding major space policy issues and guidance on how to meet their challenges. ●

As the world's leading space power, with more civilian and military space assets in orbit than any other country, the United States also plays a central role in shaping the development of norms and rules for safe and peaceful activities in outer space.

The Current Space Landscape

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The Current Space Landscape

In recent years, the space environment has become increasingly complex. More actors, including governments and industry operators, are fielding space systems and developing new terrestrial applications and benefits that rely upon those space systems. This trend has accelerated in recent years as the space domain shifts from a government-driven domain to a multiuser domain (government, industry, academia). Space activities are a key element of diplomatic and national security strategies, and a supporting element of policies to advance scientific knowledge and societal benefit. Increasingly, space capabilities are also becoming a core part of commercial and economic strategy and policy. As the world's leading space power, the United States remains at the forefront of most space sector developments, although both allied and competitor nations are rapidly increasing their capabilities.

Over 11,200 functional satellites orbit the Earth, providing tangible social, scientific, strategic, and economic benefits to billions of individuals throughout the globe. More than half of these satellites are operated by American agencies, companies, or organizations. In the U.S., a small number of commercial companies currently operate over 90 percent of the country's operational satellites on orbit.[1] Globally, at least 100 countries operate satellites.[2] Many of these commercial and governmental actors in space are new to the domain and may be unaware of existing operational best practices for safe and sustainable space operations.

In addition to the active satellites in space, there is a large and growing number of objects in space that serve no useful purpose. Orbital debris—dead satellites, spent rocket stages, and other fragments associated with humanity's activities in space—represents a growing threat to active satellites. The United States is currently tracking more than 36,700 debris objects in Earth orbit, most of which are pieces of human-generated orbital debris larger than 4 inches in size, each of which could destroy an active satellite in a collision.[3] Statistical modeling indicates there are an estimated 1.1 million pieces of orbital debris between 0.4 and 4 inches in size that

1 Union of Concerned Scientists, *Satellite Database* (Washington, DC: Union of Concerned Scientists, accessed February 12, 2025), https://www.ucsusa.org/resources/satellite-database. Data as of May 1, 2023.

2 T.S. Kelso, *SATCAT Boxscore* (CelesTrak, accessed February 12, 2025), https://celestrak.org/satcat/boxscore.php.

3 European Space Agency, *Space Debris by the Numbers* (accessed February 12, 2025), https://www.esa.int/Space_Safety/Space_Debris/Space_debris_by_the_numbers.

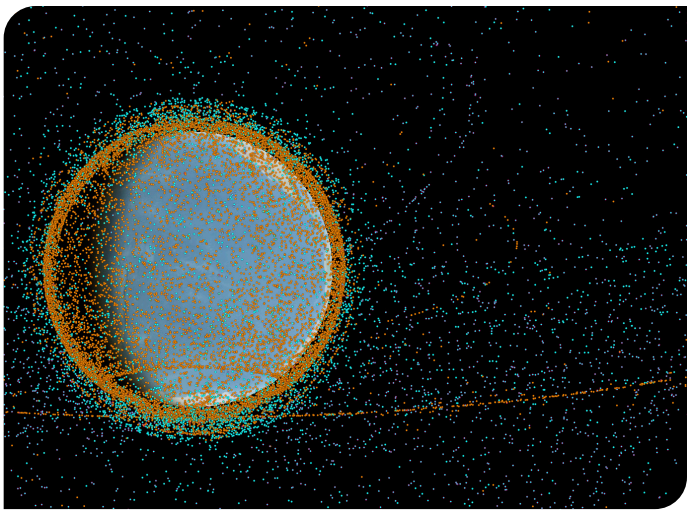

Figure 01 | Active satellites, in orange, and all other debris objects, in blue. Not to scale. *Credit: Astriagraph*

are largely untracked, each of which could severely damage an active satellite in a collision. Continued growth of the orbital debris population and failure to implement improved spacecraft operations practices could lead to a sharp decrease in our ability to sustain the benefits that space systems provide to the entire world.

The United States is currently the world leader in tracking and providing knowledge about the space environment and human activities in space—a capability set known as space situational awareness (SSA). As the space environment becomes more complex, with more actors and increasing potential interactions among satellite operators, SSA capabilities are becoming increasingly critical to the safety of operations. The United States provides SSA information to the global community as a matter of spaceflight safety and has over 185 SSA sharing agreements signed with countries, companies, and intergovernmental organizations that allow for the sharing of more specific SSA data.

Space applications also provide a critical service in supporting human and environmental security needs on Earth. Space systems, including position, navigation and timing (PNT), Earth observation, and telecommunications satellites, provide significant benefits in addressing a wide variety of human and environmental concerns. American capabilities and systems are a key part of a global system of space applications. However, the full utility of these important systems can be blunted by a variety of institutional, policy, educational, and social barriers. As a result, benefits from these systems do not always adequately reach decision-makers or citizens when they need it most.

Space technologies also play an important role in both national and international security. The military use of space includes spacecraft designed to support terrestrial military and intelligence operations, such as global PNT systems, as well as communications and intelligence, surveillance, and reconnaissance (ISR) satellites. As more countries integrate space into their national military capabilities and rely on space-based information and services for their national security, there is an increased chance that any interference—either actual or perceived—with satellites could spark or escalate tensions and conflict in space or on Earth. This is made more difficult by the challenge of determining the exact cause of a satellite malfunction. Some states are developing or have developed a range of counterspace capabilities, including ground- and space-based objects, that could be used to deceive, disrupt, deny, degrade, or destroy space systems.

As space activities have grown, a multilateral governance and coordination system has evolved. The principal international fora for discussing questions related to space affairs are the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS), the International Telecommunication Union (ITU), the Conference on Disarmament (CD), and the UN General Assembly. Of these fora, COPUOS is the leading multilateral body for discussing questions of international cooperation in space activities. It was responsible for crafting the 1967 Outer Space Treaty, which set out the foundations of international space law that were then elaborated upon in later agreements. From its initial 24 founding members in 1959, the membership

of COPUOS has increased to 104 members, with more countries applying for membership each year, underscoring the growing importance of discussions held there. The United States has historically been an active and leading participant in multilateral discussions of space governance and has helped to shape a principles-based governance regime reflective of American values that has been largely supportive of space activities. U.S. leadership in these discussions remains critical moving forward as a growing number of countries plan and conduct lunar missions, as well as the commercial sector.

Domestically, many agencies have a role in space policy and regulation in the United States. These include the Departments of Defense, Commerce, Transportation, Energy, and State, as well as specialized agencies such as the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration, and the Federal Communications Commission. Agencies may act in a regulatory role, a promotional role, a user role, or a development role, or some combination of these. Congress also has a fundamental role in both the promotion and governance of space activities, with space-focused subcommittees in both the House of Representatives and the Senate. Historically, space has been seen as a nonpartisan issue in Congress, with differences between chambers or geographical constituencies often playing more of a role than party affiliation.

The first Trump administration reestablished the National Space Council (NSpC) as the main hub for interagency coordination on space policy and expanded its membership to include additional agencies. Under the first Trump administration, the

As the world's leading space power, the United States remains at the forefront of most space sector developments, although both allied and competitor nations are rapidly increasing their capabilities.

NSpC issued seven Space Policy Directives (SPDs), which did everything from announcing goals for NASA's human spaceflight program to establishing the Space Force. The SPDs issued during the Trump administration also included initiating an important transition of civil SSA and space safety services from the Department of Defense to the Department of Commerce. The reinstatement of an NSpC served a useful purpose in improving whole-of-government consideration of space activities within the Executive Branch. The Biden administration maintained the NSpC, kept up momentum for the Artemis program, and added many more signatories to the Artemis Accords. Under Biden, the Office of Science and Technology Policy issued a Cislunar Science and Technology Strategy, announcing goals for technical capabilities such as PNT and SSA for the cislunar environment.[4] On the international level, the Biden administration led discussions on norms of responsible behavior at the United Nations, which achieved a General Assembly resolution that broadly condemned programs that would place a nuclear weapon in orbit.

Looking ahead, the United States must remain a global leader in promoting space activities in a sustainable fashion, including supporting the development of national and international space governance. ●

4 White House Fact Sheet, *First National Cislunar Science & Technology Strategy*, https://www.whitehouse.gov/ostp/news-updates/2022/11/17/fact-sheet-first-national-cislunar-science-technology-strategy/

What Is Space Sustainability and Why Is It Important?

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What Is Space Sustainability and Why Is It Important?

More than 11,200 active satellites currently orbit the Earth, providing tangible social, scientific, security, and economic benefits to billions of individuals all over the globe. Yet the ability to provide these important benefits from outer space is now threatened by a number of challenges. The Earth's orbital space environment constitutes a finite resource that is being used by an increasing number of space actors.

The proliferation of space debris, the emergence of a large number of new space actors, the rapidly increasing number of operational satellites in orbit, and the increasing variety and complexity of space operations pose increased risks of collision and interference with the operation of satellites and crewed space vehicles. In addition, as more countries integrate space into their national military capabilities and rely on space-based information and services for their national security, there is an increased chance that any interference with satellites could escalate tensions and conflict—in space or on Earth.

Taken together, all of these developments pose risks to the safety of space operations and raise concerns about the potential for severe degradation of the Earth's orbital and cislunar space environment. Such degradation could render the space domain unusable for the systems that form part of the critical infrastructure of many states, as well as space systems that provide economically important space-derived information and services used by billions of people daily.

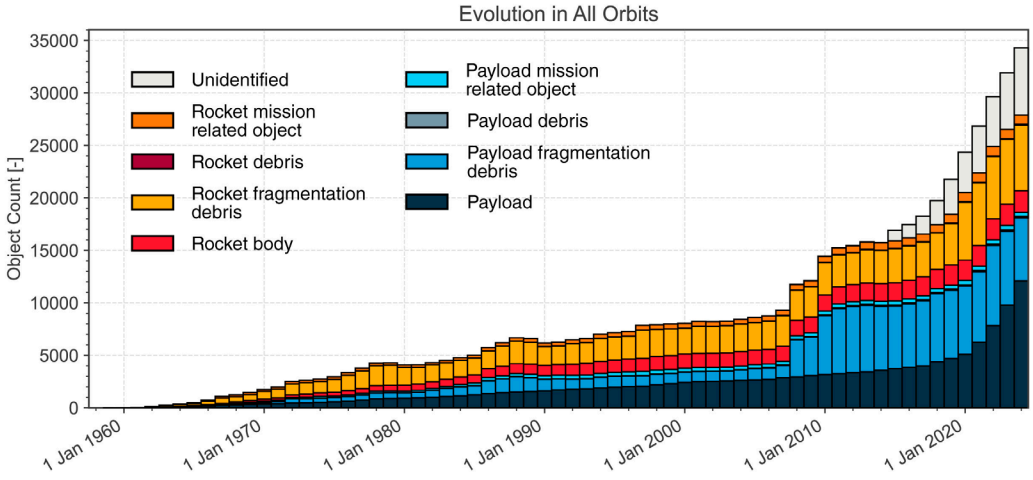

Figure 02 | Evolution of number of objects in geocentric orbit by object class. *Credit: European Space Agency*

Space sustainability refers to addressing challenges to the safety and long-term viability of space activities collectively to ensure that the space environment remains suitable for exploration and use by the current and future generations of all countries.

As the world's leading space power and user of space, it is in the interest of the United States to be at the vanguard of establishing and promoting best practices for responsible, peaceful, safe, and sustainable conduct of space activities. This issue briefing examines the space landscape and developments in the space arena from a space sustainability perspective and suggests ways in which the United States can continue to provide leadership to the international space community. •

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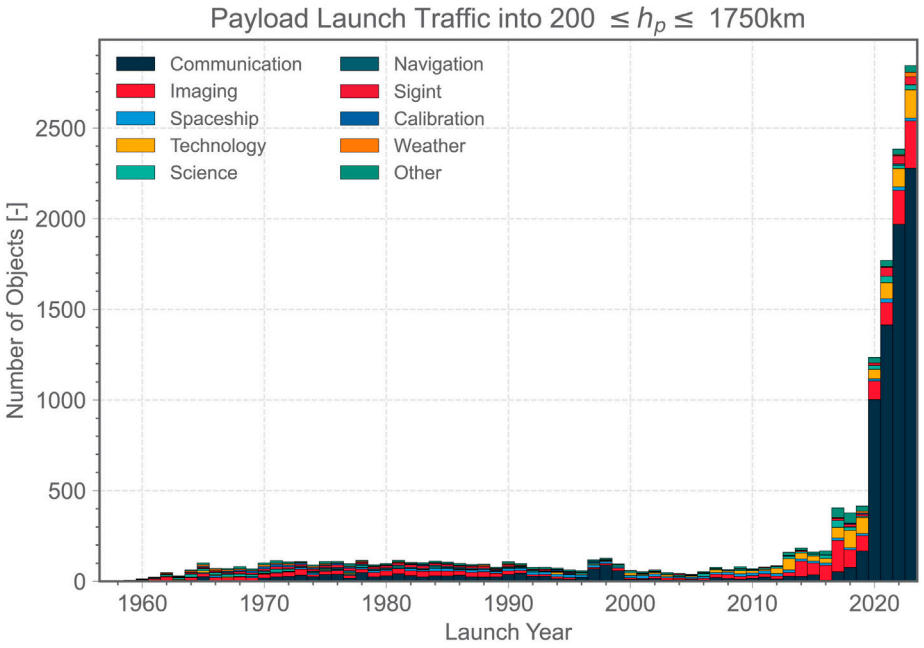

Figure 03 | Evolution of the launch traffic near LEO_{IADC} per mission type. *Credit: European Space Agency*

Policy Recommendations

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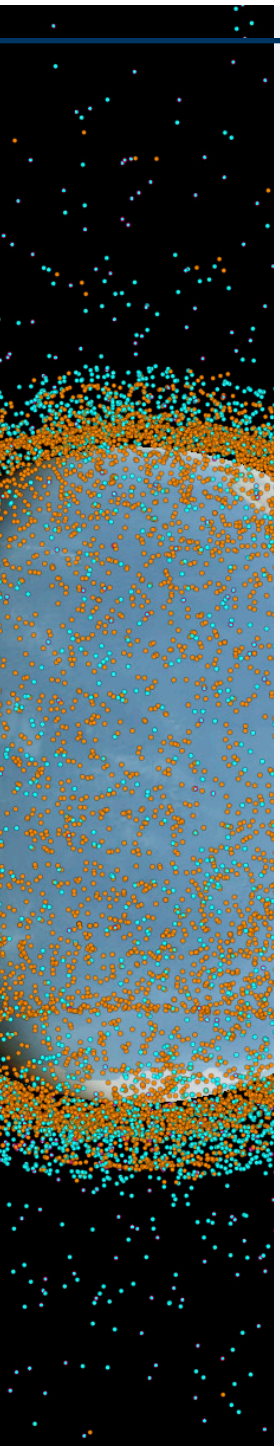
Policy Recommendations



Taking Action on Orbital Debris

Harmonize orbital debris mitigation requirements across licensing authorities under one regulatory agency.

Currently, orbital debris mitigation requirements are part of licenses issued by three different U.S. federal agencies: the Federal Aviation Administration, the National Oceanic and Atmospheric Administration, and the Federal Communications Commission. While consolidation of licensing into a single entity is not achievable, the National Space Council or its equivalent should coordinate interagency processes to ensure space debris mitigation requirements are consistent across licensing agencies in order to support efficiency in licensing processes and certainty for operators applying for licensing.

Initiate a national active debris removal mission to leverage commercial capabilities.

The United States government—through NASA—should establish a program to fund and conduct the removal of a U.S.-government-owned legacy space debris object, preferably a large rocket body. This mission should be conducted as a public-private partnership through NASA and would leverage existing NASA technical capability and investment related to in-space servicing, assembly, and manufacturing (ISAM) as well as emerging industry capabilities related to satellite servicing and in-space logistics. It is important that a national orbital debris removal mission be conducted by a civil government agency (rather than the Department of Defense and/or Space Force) in order to ensure that active debris removal (ADR) action is not seen as a threatening or adversarial capability. Such a mission would help to establish U.S. leadership in orbital debris remediation and set an example to both adversary nations and allies of the importance of taking responsible action to remediate national legacy debris objects.

Continue to support the development of commercial in-space servicing, assembly, and manufacturing (ISAM) capabilities.

Government support for commercial ISAM capabilities—in terms of both contracting and R&D funding—provides important adjacent and complementary technology and services useful to advance debris remediation capabilities. The U.S. government should continue to support this emerging growth area in the space economy, including purchasing commercial services and not developing government capabilities that compete with industry offerings. For both efficiency and economic development purposes, it is also important to leverage and use industry and/or voluntary consensus standards in areas like refueling, docking, and interfaces instead of developing bespoke requirements in government procurements.

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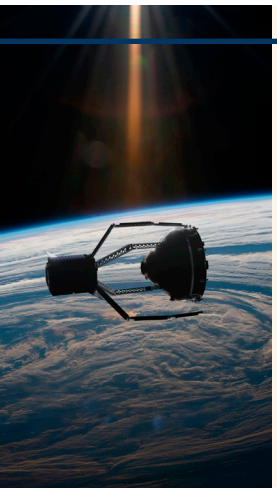
Image credit: Astriagraph.



Focus Issue: Conducting a National Active Debris Removal Mission

The U.S. government—through NASA—should establish a program to fund and conduct the removal of a U.S.-government-owned space debris object, preferably a large rocket body.

This mission should be conducted as a public-private partnership through NASA and would leverage existing NASA technical capability and investment related to in-space servicing, assembly, and manufacturing (ISAM), as well as emerging industry capabilities related to satellite servicing and in-space logistics. Such a mission would help to establish U.S. leadership in orbital debris remediation and set an example of responsibility in the importance of taking responsible action in support of the space economy. It would also deepen U.S. industry capabilities related to commercial markets in ISAM. **VIEW MORE ➔**

Image credit: ESA.

Strengthening Space and National Security

Refer to space as an "operational" domain rather than a "warfighting" domain.

By referring to space as a "warfighting" domain, the United States has handed its adversaries an easy diplomatic win by allowing them to use that phrasing as evidence that the United States is the one increasing tensions and weaponizing space. Referring to space as an operational domain would be an acknowledgment of how the military needs to continue to operate in and through space, would be in line with how others refer to it (including NATO), but would not hamper U.S. diplomatic efforts required to meet national security space concerns and goals.

Discourage the deliberate creation of debris.

The United States should maintain its current policy of committing not to conduct destructive direct-ascent anti-satellite (DA-ASAT) missile tests, as well as continuing to promote this during multilateral discussions in order to stigmatize this sort of testing and also encourage others to commit to this as an emerging international norm of responsible behavior in space.

Establish international norms of behavior for military space activities.

The United States should work with other countries to establish common understandings for what is considered responsible behavior in space, particularly for military activities that could cause misperceptions or increase tensions, such as rendezvous and proximity operations in orbit. The United States should use space situational awareness in order to help verify such actions.

Redouble efforts to improve resilience.

The United States needs to continue working to ensure the resiliency of its space assets via more responsive space launch, proliferated satellite architectures across multiple orbits and payloads, and more use of U.S. commercial capabilities, as well as the capabilities of U.S. allies.

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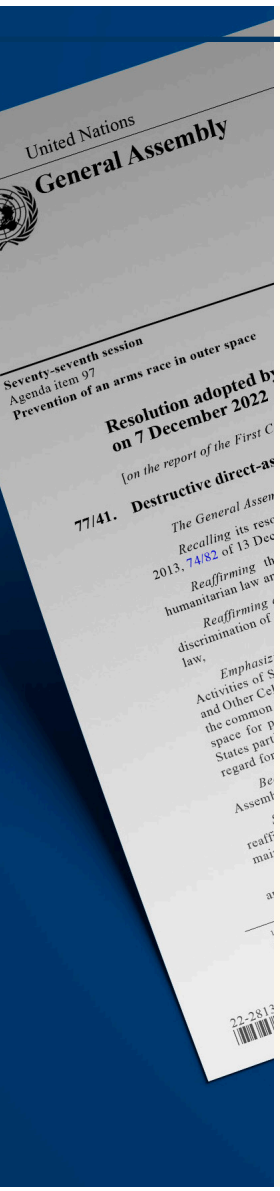
Credit: Jeremy Bishop on Unsplash



Focus Issue: Continuing the Destructive DA-ASAT Missile Test Moratorium

Continue to support the destructive direct-ascent anti-satellite (DA-ASAT) missile test moratorium as a matter of U.S. policy.

The United States should continue to demonstrate leadership in norm-building by continuing to support the commitment not to conduct destructive DA-ASAT missile tests, both in terms of a policy that the United States will hold itself to and to promote more countries making this commitment themselves. The United States benefits from the stable, predictable space environment resulting from this moratorium.

Maintain a policy of not deliberately creating debris during military space activities and missions.

Deliberately creating debris on orbit will hamper the United States' ability to use and operate through space, ultimately harming U.S. national security. If the United States sets the precedent that this sort of action is acceptable, rival countries will follow, and ultimately the United States will comparatively suffer the most and thus be worse off than its adversaries.

Provide leadership in multilateral space security fora to shape norms of responsible behavior in space.

In April 2025, the United Nations is starting a four-year process of discussing issues related to space security called an "Open-ended working group on the prevention of an arms race in outer space in all its aspects." This is an excellent opportunity to generate momentum for international support of the idea that responsible space actors do not deliberately create debris on orbit through destructive DA-ASAT missile tests. Active participation in this forum would send a strong signal to the international community that the United States will continue to show leadership in being committed to the safety, security, stability, and long-term sustainability of space activities. Furthermore, it will provide a way to counter the influence of adversary nations in this forum; otherwise, in the absence of United States engagement and leadership, the discussions and outcome will be shaped to its adversaries' advantage.

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Fostering Commercial Space With Efficient Policy and Oversight Tools

The Office of Space Commerce (OSC) within the Department of Commerce should act as the lead agency for the authorization and supervision of private sector space activities.

A clear and certain oversight process should be implemented with one agency designated as a lead to close the gap in licensing of commercial space operations and ensure consistency across the U.S. government. This agency should be the Office of Space Commerce (OSC) within the Department of Commerce and should be elevated out of the National Oceanic and Atmospheric Administration (NOAA) to an office within the Office of the Secretary of Commerce. Making OSC the lead agency will complement its developing role of providing civil space situational awareness data and services to support spaceflight safety as it works towards developing a future space traffic coordination system.

Implement mission authorization through an interagency process, with OSC as the lead.

Acting as the lead agency for the authorization and supervision of private sector space activities, OSC should serve as a clearinghouse or tracking point for private sector space activities seeking government approval. This will provide more clarity for commercial companies who may not otherwise know who to go to in the U.S. government for a license and also help OSC better understand the breadth and scope of private sector space activities to inform its mission to promote such activities. For further discussion of mission authorization, please refer to the focus section.

Ensure licensing authorities are resourced at levels to ensure responsiveness.

Efforts to reform regulatory provisions to enhance the competitiveness of the U.S. space industry must be complemented by ensuring that licensing authorities have the appropriate amount of budgetary and staffing resources to respond to applications and issue licenses in an efficient manner. This should include retaining the Space Bureau at the Federal Communications Commission (FCC), which has made progress in enhancing the responsiveness of that agency to satellite industry activities.

Establish an international dialogue on oversight of commercial space.

In order to improve the linkages between commercial space and foreign and trade policy, the U.S. government should pursue an active strategy of diplomatic and civil society dialogue on international approaches to commercial space sector policy, including with competitor nations. Such an approach will help to identify and share regulatory best practices, reduce the risk of regulatory fragmentation and forum shopping, and potentially help to identify trade opportunities for U.S. companies. It will help to ensure that the United States is at the forefront of establishing the values that define economic competition in the space market.

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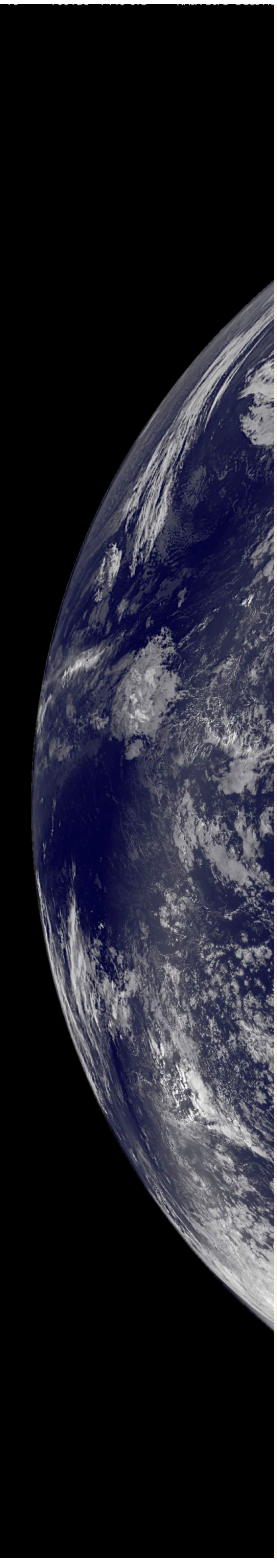
Credit: NASA



Ensuring Operational Continuity and Safety through Space Situational Awareness and Space Traffic Coordination

Maintain efforts to implement Space Policy Directive (SPD)-3 and the Traffic Coordination System for Space (TraCSS).

Since the finalization and publication of SPD-3, the Office of Space Commerce (OSC) has made steady progress on implementing a civil space traffic coordination system. As TraCSS continues to transition from initial operations to its planned full-scale service, it is of great importance to ensure continuity in this program and work across the administration and Congress to provide full funding for the Office of Space Commerce to implement TraCSS. A civil space traffic coordination (STC) system is a key enabler of maintaining the United States' leadership in growing the space economy, supporting continuity and safety of operations by commercial space actors (as well as other users of the space environment). Transitioning this function from the Department of Defense to the Office of Space Commerce also promotes efficiency by enabling DoD to focus its space situational awareness (SSA) efforts on fulfilling its national security missions.

Lead International Efforts Towards Space Traffic Coordination.

As large satellite constellations are deployed, led in large part by U.S. operators, the need to have processes, practices, and methods in place to share basic space safety information, in order to protect operational continuity and maintain stability in the operating environment, increases. U.S. operators will need to ensure that space safety information can be exchanged with operators from other jurisdictions. With the existing operational expertise of its operators, its existing base of SSA sensors and data, and the deployment of the TraCSS system, the United States is positioned to lead international efforts to establish these basic coordination practices. The United States should proactively engage in international conversations to develop STC mechanisms, which might be voluntary in nature, including working closely with allied efforts, such as the EU Space Surveillance and Tracking (EU SST) program, to ensure an efficient and effective coordination network emerges that supports U.S. interests and a stable environment conducive to the long-term growth of space activities.

Leverage commercial capabilities to the maximum extent while also supporting SSA as a public good.

Both the DoD and OSC TraCSS should purchase commercial SSA data and services and pursue international data-sharing agreements in lieu of building new government capabilities. This will promote efficiency, support industry development, and allow the DoD to prioritize existing national sensor networks to support national security needs. The United States should also make basic space safety information services as publicly and freely available as possible. The private sector should be incentivized to develop innovative analytical tools and advanced services based both on public services as well as the data collected by commercial firms.

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Credit: NASA

Focus Issue: Implementing Mission Authorization

Implement mission authorization through an interagency process, with the Office of Space Commerce (OSC) as the lead.

Acting as the lead agency for the authorization and supervision of private sector space activities, OSC should serve as a clearinghouse or tracking point for private sector space activities seeking government approval. This will provide more clarity for commercial companies who may not otherwise know who to go to in the U.S. government for a license and also help OSC better understand the breadth and scope of private sector space activities to inform its mission to promote such activities.

The OSC should act as the lead agency for the authorization and supervision of private sector space activities.

A clear and certain oversight process should be implemented with one agency designated as a lead to close the gap in licensing of commercial space operations and ensure consistency across the U.S. government. This agency should be the OSC within the Department of Commerce and should be elevated out of the National Oceanic and Atmospheric Administration (NOAA) to an office within the Office of the Secretary of Commerce. To make this process as effective as possible, the following elements should be included:

- For all activities not covered under existing authorities at the Federal Communications Commission (FCC), Federal Aviation Administration (FAA), and NOAA, OSC should serve as the interface point for licensee applicants for tracking applications and processing times. A clear timeline should be established for licensing processes, and the OSC should be the point of contact for applicants seeking updates on the expected processing timelines for their applications. Where interagency coordination is required in the licensing process, this clearinghouse function would provide administrative support for that coordination and serve as a single point of information for applicants. Establishing OSC as such a clearinghouse would improve the competitiveness of the U.S. space industry by reducing the challenges companies face in identifying and interfacing with the appropriate licensing authorities.
- Mission authorization should apply to the mission conducted by a spacecraft over its lifetime as a whole (as opposed to requiring separate approvals or processes for each individual part of a mission). It would effectively serve as a "license to operate" within certain pre-approved parameters, that are defined in the initial license.
- In the interests of promoting a safe operating environment for all commercial space businesses, licensing conditions should ensure that basic space safety requirements are met (including registration with SSA service providers and compliance with space debris mitigation guidelines) and should seek to ensure uniformity in application of these requirements to all operators of the same type of mission. Such uniformity is essential to ensure individual operators are not unfairly advantaged or disadvantaged by the authorization process. Licenses should be based on a presumption of approval, with the burden on the government to describe rationale for denial, in such cases. Attention should be given to long-term externalities of the licensing decisions.

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Credit: NASA

Leveraging a Whole-of-Government Approach to Drive Space Policy Leadership

Keep an executive branch coordination mechanism for space policy, such as the National Space Council.

Given the increasing strategic and economic importance of the space sector, it is important to ensure there is a high-level coordination of federal policy for this domain. The National Space Council (NSpC), or another similar coordinating mechanism, should be implemented as the main body for developing national space policy and should be staffed with experts from inside and outside the U.S. government, specifically those who understand the interagency process and the importance of space. It would also be beneficial to consider ways to include the Federal Communications Commission in NSpC discussions, when relevant, to enhance the coordination of policy.

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Credit: NASA

Supporting Multilateral Space Diplomacy

Work with and through multilateral fora to help shape international consensus on norms of behavior, standards, and practices to enhance the safety and sustainability of space activities.

As noted previously, the rapid increase in the number of spacefaring countries, the rise of commercial actors, and the proliferation of counterspace capabilities globally are transforming the outer space environment and posing numerous challenges for all space actors. The United States cannot address these developments on its own, as it requires international cooperation both to promulgate the behaviors and best practices to ensure long-term sustainability and security, but also just due to sheer physics, the activities of a single actor have the potential to affect everyone's ability to continue to utilize space. Therefore, the United States should continue to actively pursue the development of norms of responsible behavior and provide leadership in the development of international consensus standards and best practices to enhance the security, safety, and sustainability of space activities through engagement with the appropriate international and multilateral fora. One of the norms the United States should continue to promote is the decision not to conduct destructive direct-ascent anti-satellite (DA-ASAT) missile tests.

Continued on page 08 ➔

Supporting Multilateral Space Diplomacy *(continued)*

Harness its leadership in space exploration to preserve the stability, safety, and security of the space environment and to support multilateral efforts to improve cooperative space governance.

Given the increasing number and diversity of spacefaring nations, international cooperation is becoming ever more important to preserve the stability, safety, and security of the space environment. The Artemis Accords provide a valuable opportunity to use space exploration as a tool of diplomacy in support of the United States' objectives to promote the rule of law in space to ensure the safety, stability, and security of space activities. It also provides an opportunity to engage new, nontraditional partners in emerging space countries. In this regard, the United States should continue to seek new signatories for the Artemis Accords, provide more tangible ways to link Accords signatories to Artemis Program participation as a way of solidifying partnership relationships and benefits, and use the momentum generated from signatories' support of the U.S. goals and policies to translate that into support of U.S. goals for the Committee on the Peaceful Uses of Outer Space (COPUOS).

Use the expertise of domestic commercial and other nongovernmental stakeholders to achieve its international space diplomacy goals.

In support of the United States' engagement in international multilateral space diplomacy, particularly with regard to negotiations that may have domestic regulatory implications, it is important to engage domestic stakeholders to obtain their input so that the United States can help to provide sound leadership in these multilateral fora to develop pragmatic and workable solutions that are aligned with established best practices. In addition, the United States should harness the expertise in the commercial, academic, and nonprofit sectors to support engagement in both formal and informal multilateral dialogues that help to build and sustain international connections, relationships, information sharing, and confidence building.

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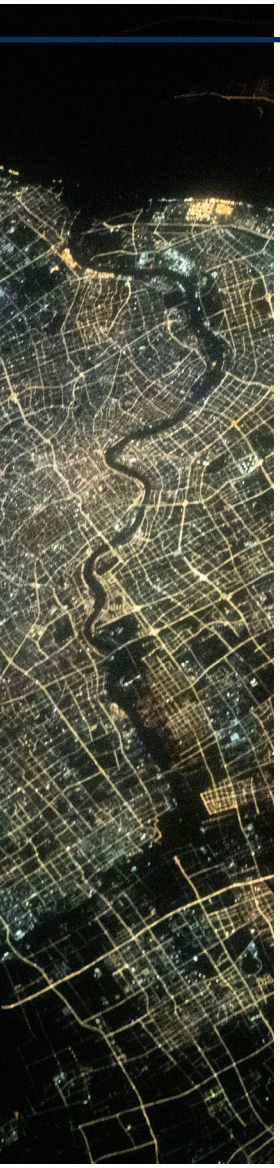

Engaging with China on Space Activities

Reassess the Wolf Amendment to allow for limited space engagement with China.

Working with the Trump administration, Congress should review and revise the implementation of the Wolf Amendment to increase NASA's engagement in space activities with China that support U.S. national interests. Priority areas for engagement include basic space science and research, robotic space exploration, human spaceflight safety, lunar search and rescue, and increased data sharing on space weather and orbital debris.

Expand the Space Safety Dialogue with Chinese actors.

The United States and China have shared interests in ensuring basic operational safety in the space environment, including both in low Earth orbit (LEO) and in cislunar space (including the lunar surface). Establishing channels for information sharing and promoting space safety practices can act to reduce the potential for misunderstanding that might lead to conflict while promoting stability in the operating domain that will support growth in space activities. This is particularly important in the context of national space traffic management and/or coordination initiatives. Dialogue of this type might be pursued in several ways, including: bilateral government-to-government discussions; informal civil society dialogues; and engagement in multilateral fora such as the proposed Consultative Mechanism on Lunar Activities at the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS).

Increase understanding of the Chinese space sector.

Congress should work with the Trump administration to fund and carry out studies that systematically document and understand the structure and nature of the Chinese space ecosystem, how the industry is structured, the true relationships between the central government, the state-owned enterprises, and the private companies, the role of the provincial governments, how private capital operates in the Chinese space sector and how all of this relates to the space program priorities of the Chinese government.

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Credit: NASA

Ensuring U.S. Leadership in Space Exploration and Development

Sustain commitment to the Artemis program.

The Administration should reaffirm its commitment to the Artemis program and U.S. leadership in lunar exploration.. Technologically, the Moon is the gateway to Mars, and many international arrangements have been made under the Artemis program and Artemis Accords—the reneging of which would harm U.S. space leadership and space diplomacy. The Administration should work with Congress to establish bipartisan support for a sustained crewed lunar exploration program that serves as the cornerstone of further space exploration and development.

Continue to work with the international community to implement the Artemis Accords.

The principles of the Artemis Accords represent a practical approach forward to addressing several cislunar governance issues. Efforts should be made to continue to work towards the adoption of these Accords, including engagement with possible competitor nations. In addition to seeking new countries to sign the Artemis Accords, efforts should be made to coordinate and engage with existing members, including with options and opportunities in the Artemis program.

Continue multilateral engagement on space resources governance.

The United States should continue to positively engage in discussions at the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) and other multilateral fora to develop consensus principles to enable space resources activities. These principles can complement U.S.-led approaches like the Artemis Accords and serve a coordinating function.

Employ the U.S. Space Force to support increased Cislunar situational awareness.

While the United States should continue to observe its international legal obligations not to put military installations on the Moon or conduct military maneuvers there, there remains a role for the U.S. military to continue to help enhance cislunar situational awareness as a matter of spaceflight safety for the increased number of lunar missions.

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Credit: NASA

Improving U.S. Space Weather Capabilities

Maintain whole-of-government focus across administrations and with support from Congress.

When the space weather-focused agencies of the executive branch work in tandem with the authorizing and appropriating committees in Congress, it can result in more effective policy. For consistency across presidential administrations and continuity of purpose for missions, the implementation of the Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow (PROSWIFT) Act and the accompanying recommendations made by the Space Weather Advisory Group (SWAG) should guide the executive agencies. This includes ensuring adequate funding is made available for implementation.

Ensure continued data collection sources through the protection of space-, ground-, and air-based sensors.

The United States' solar observing satellites and other space weather observation infrastructure are aging, and unexpected failures could lead to gaps in data collection. As we go further into Solar Cycle 25, the erosion of capabilities across the solar observation fleet will only increase. In order to maintain data collection to advance monitoring and forecasting of extreme space weather, a pipeline of new space- and ground-based observing systems must be initiated.

Work with international partners to augment observations and research.

Similar to capacity in space exploration and R&D budgets, the United States spends the largest amount of money on space weather-focused science across the world. Yet, regional monitoring and capacity are necessary to better understand and mitigate the effects of space weather on localities around the world, ultimately also protecting U.S. assets and interests. U.S. leadership in these efforts can build global capacity and can work to augment capabilities rather than duplicate efforts.

Support the development of commercial space weather services.

Satellite companies, hardware manufacturers, researchers with operational concepts, and others are in the nascent stages of developing a commercial space weather enterprise. A delineation of what information and baselines the U.S. government will provide will go a long way to providing a stable innovation space for companies, while ensuring that commercial products meet the needs of U.S. space weather priorities.

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Credit: NASA

Maximizing Value from Earth Observing Systems

Support continuity of service for all Earth-observing satellite capabilities and continue to champion free and open data-sharing principles.

The U.S. government should remain committed through policy and funding to having an appropriate pipeline of essential meteorological satellites and should extend the same commitment to continuity of coverage for land observing systems. Further, the government should continue to adhere to the core principle of free and open by supporting technology and best practices designed to improve data discoverability and usability.

Enable commercial sector value-added services and promote a thriving American commercial remote sensing industry.

The U.S. government should include expanding public-private partnerships to increase the use and value of Earth observation data that is already being produced. The government should also continue to improve the regulatory environment for U.S. companies by ensuring that implementation of recent rule changes is carried out swiftly and with clear guidance. Industry and other stakeholders should be fully consulted to ensure that any additional oversight and licensing rules are updated as needs evolve. A further update of older legislation, such as the Land Remote Sensing Policy Act of 1992, may also be required to accomplish this.

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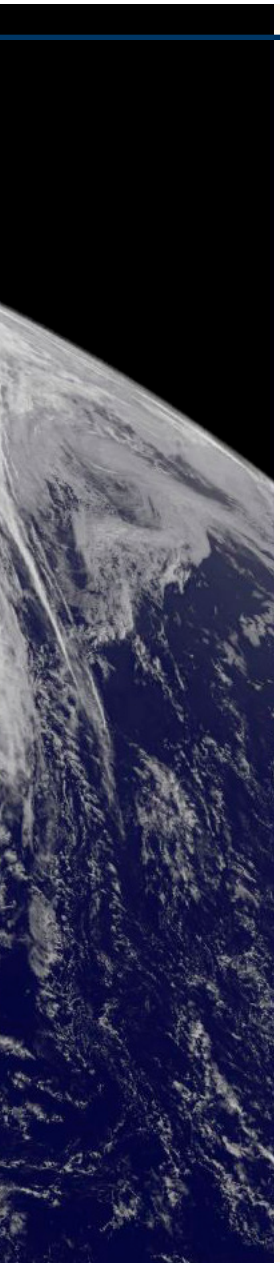
Credit: NASA



Leading on Global Planetary Defense Efforts

NASA and its national partners should be given the assets and resources to complete the task assigned by Congress of the cataloging and orbital characterization of near-Earth objects (NEOs) 140 meters and larger.

The larger NEOs have been detected, but many smaller yet still potentially threatening NEOs remain undetected. Finding these remaining NEOs will be harder and space-based telescopes appear to be the best path forward. NASA should be funded to mount these space-based NEO threat detection missions.

Clarify the existing rules—including rights and responsibilities—for any mission to divert or destroy an impending NEO strike, as well as establish the legality of using a nuclear explosive device for eliminating imminent NEO impact threats where no other options exist.

Legal issues of asteroid redirect missions are currently uncertain under existing international space law rules, and coordination and agreement on an international level should be sought. Additionally, the legality of the use of a nuclear explosive device for the largest and most urgent NEO threats should be agreed upon by countries before the Earth is faced with such a situation that requires a swift and coordinated international response. Proactive and results-oriented discussions at the international level, including through SMPAG and at the United Nations Committee on the Peaceful Uses of Outer Space, to address these questions is needed. The United States is uniquely placed to provide leadership in such discussions.

Achieve the goals of interagency, federal, state, and local preparedness outlined in the 2018 Near-Earth Object Preparedness Strategy and Action Plan.

These include strengthening and routinely exercising the communication of threats, and response and recovery efforts by agencies such as the Federal Emergency Management Agency and the Department of Homeland Security. Sufficient training and resources to these agencies is required to accomplish this preparedness task.

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Credit: NASA

Taking Action on Orbital Debris

Relevant to:

The White House

National Aeronautics and Space Administration

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Taking Action on Orbital Debris

Orbital debris consists of dead satellites, spent rocket stages, and other remnants of human activity in space that have accumulated in Earth's orbit and present a hazard to current and future space activities. Managing this risk is a collective action problem that will require stakeholders to adopt new practices and accept costs now to forestall large negative impacts on space activities in the future. A U.S. policy approach should be focused on both mitigation and remediation actions related to orbital debris, in the interests of safety and stability for American military, civil, and commercial users of space systems.

Background

Orbital debris—dead satellites, spent rocket stages, and other fragments associated with humanity's nearly seven decades of activity in space—represents a growing threat to active satellites and crewed space missions. The United States is, as of the end of January 2025, tracking about 36,700 pieces of human-generated debris in Earth orbit larger than 4 inches (10 centimeters) in size, each of which could destroy an active satellite in a collision. Statistical modeling indicates there are an estimated 1,100,000 pieces of orbital debris between 0.4 and 4 inches (1 and 10 centimeters) in size that are largely untracked, each of which could severely damage an active satellite in a collision.[1] This existing orbital debris is largely concentrated in the same altitudes that are heavily used by satellites, particularly in low Earth orbit (LEO) between 600 and 900 kilometers (372 and 559 miles) and geostationary Earth orbit at 36,000 kilometers (22,369 miles).

The continued growth of space debris and increasing collision risk in orbit represent a hazard to the economic and societal benefits of space activities. Satellites operating in congested regions already have to manage a growing number of close-approach warnings and potentially expend fuel to avoid potential collisions. If the amount of debris is allowed to grow unchecked, we may see what is described as the "Kessler Syndrome," where, as the amount of debris in orbit grows, the increasing density of space objects will lead to random collisions, which in turn generate debris at a rate faster than can be naturally removed from orbit by the Earth's atmosphere. This could result in some orbits becoming too expensive to operate in, as satellites would have to continually move to avoid being hit by debris.

Since the early 1990s, the main policy focus to deal with orbital debris has been to develop mitigation practices that reduce the creation of orbital debris from space activities. More than a dozen national

1 https://www.space-track.org/

space agencies participate in the Inter-Agency Orbital Debris Coordination Committee (IADC) to develop technical standards for orbital debris mitigation. While the IADC standards themselves are voluntary, a growing number of countries have put in place national policies and regulatory frameworks to implement these debris mitigation standards. A growing number of private sector efforts have also established their own best practices that often go beyond the IADC standards.

While mitigation reduces future growth in the orbital debris population, it does not address the existing debris. Remediation of orbital debris—including active debris removal (ADR)—is also necessary. Remediation of existing debris objects has been, and remains, a difficult technical, political, legal, and business challenge to solve. One of the biggest sources of risk comes from large debris objects in LEO that are part of the legacy of previous governmental space activities—for the most part, that of the United States, Russia (including historical Soviet objects), and China.

Current Policy and Gaps or Shortcomings

In the United States, NASA is the lead agency for developing debris mitigation-related technical standards, which are encapsulated in the U.S. Government Orbital Debris Mitigation Standard Practices (ODMSP). Other federal agencies are expected to apply the ODMSP to their own space activities and implement them in their licensing of U.S. private sector space activities. However, there are differences in how each agency has implemented the ODMSP and concerns that the ODMSP have not gone far enough to address the emerging challenges posed by small satellites and large constellations. In September 2022, the Federal Communications Commission (FCC) adopted a requirement for its licensees in low Earth orbit to dispose of their satellites within five years of completing their missions. This requirement goes beyond what is in the ODMSP but matches with practices many commercial operators are adopting voluntarily, driven by operational and technical needs.

Historically, orbital debris remediation or removal has not been an area of focus for the U.S. government. In January 2021, the first Trump administration released the *National Orbital Debris Research and Development Plan*,[2] which sought to provide a coordinated plan to support research and development efforts related to orbital debris risk management across the federal government. This Plan identifies areas for research and development across the three core elements of orbital debris risk management: promoting design practices that limit orbital debris; improving debris tracking and characterization capabilities; and developing capabilities related to debris remediation and repurposing. In July 2022, the Biden administration issued the *National Orbital Debris Implementation Plan*,[3] which sought to outline tangible implementation actions to build upon the 2021 *Research and Development Plan*.

In March 2024, NASA issued the first volume of its newly created Space Sustainability Strategy.[4] Part of this Strategy included a welcome policy change expanding NASA's ability to fund debris remediation technology, including operationally relevant capabilities, and to apply that technology to remediation of debris from NASA's own missions. Further leadership is required to follow up on implementation support and funding.

2 National Science and Technology Council, "National Orbital Debris Research and Development Plan," The White House, January 2021, https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/National-Orbital-Debris-RD-Plan-2021.pdf.

3 National Science and Technology Council, "National Orbital Debris Implementation Plan," The White House, July 2022, https://bidenwhitehouse.archives.gov/wp-content/uploads/2022/07/07-2022-NATIONAL-ORBITAL-DEBRIS-IMPLEMENTATION-PLAN.pdf

4 NASA, "NASA Procedural Requirements for Space Flight Program and Project Management Requirements," NASA, accessed February 8, 2025, https://nodis3.gsfc.nasa.gov/OPD_Docs/NPS_1001_111_.pdf.

The U.S. Space Force (USSF) has awarded several contracts for ADR-related technology development. In January 2022, the USSF announced the "Orbital Prime" mission, to be run by its technology branch, SpaceWERX, in order to use commercial capabilities to "recycle, reuse, or remove" space debris. Kall Morris Inc. (KMI) announced in September 2022 that it had won three USSF contracts under this program, while Turion announced in July 2024 that it had also won a contract under the same program. The optics of the USSF being possibly the most active USG funder of ADR technology are potentially problematic, as this technology is inherently dual-purpose and could be weaponized.

U.S. space industry companies, often with the support of government contracts and/or R&D funds, are advancing work on technologies and services that relate to debris remediation capabilities. Development of adjacent capabilities for in-space servicing, assembly, and manufacturing (ISAM) are helping to advance ADR-related technologies in commercially relevant rendezvous and proximity operations as well as in spacecraft grappling, berthing, and docking capabilities. Commercial space situational awareness (SSA) and non-Earth imaging capabilities and services enhance the ability to conduct characterization of debris objects and inform safe rendezvous operations. Companies are investing in novel debris remediation concepts, such as laser-based ablation and in-space recycling. Additionally, in June 2024, SpaceX was awarded a contract from NASA to develop a "U.S. Deorbit Vehicle" for the purposes of de-orbiting the International Space Station (ISS) at the end of its life.

These initiatives are positive, but there is a need for additional government action, both to sustain and scale existing programs. A number of ADR or debris remediation pilot and technology development programs are underway in Europe, Japan, and the United Kingdom, with efforts led by private companies funded by national space agencies. These programs demonstrate leadership: governments are working to develop capabilities to remove their own debris objects, while also advancing in industry development. The United States has fallen behind other nations in this area and has not made similar levels of investment. The U.S. government overall has invested relatively little in research and development of debris remediation capabilities—despite high-level policy direction to do so—and currently lacks both follow-through on the existing implementation execution strategy and a broader vision to advance space debris remediation capabilities in support of the growing space economy. ●

The continued growth of space debris and increasing collision risk in orbit represent a hazard to the economic and societal benefits of space activities.

Policy Recommendations

→ Harmonize orbital debris mitigation requirements across licensing authorities under one regulatory agency.

Currently, orbital debris mitigation requirements are part of licenses issued by three different U.S. federal agencies: the Federal Aviation Administration, the National Oceanic and Atmospheric Administration, and the Federal Communications Commission. While consolidation of licensing into a single entity is not achievable, the National Space Council or its equivalent should coordinate interagency processes to ensure space debris mitigation requirements are consistent across licensing agencies in order to support efficiency in licensing processes and certainty for operators applying for licensing.

→ Initiate a national active debris removal mission to leverage commercial capabilities.

The United States government—through NASA—should establish a program to fund and conduct the removal of a U.S.-government-owned legacy space debris object, preferably a large rocket body. This mission should be conducted as a public-private partnership through NASA and would leverage existing NASA technical capability and investment related to ISAM as well as emerging industry capabilities related to satellite servicing and in-space logistics. It is important that a national orbital debris removal mission be conducted by a civil government agency (rather than the Department of Defense and/or Space Force) in order to ensure that ADR action is not seen as a threatening or adversarial capability. Such a mission would help to establish U.S. leadership in orbital debris remediation and set an example to both adversary nations and allies of the importance of taking responsible action to remediate national legacy debris objects.

→ Continue to support the development of commercial ISAM capabilities.

Government support for commercial ISAM capabilities—in terms of both contracting and R&D funding—provides important adjacent and complementary technology and services useful to advance debris remediation capabilities. The U.S. government should continue to support this emerging growth area in the space economy, including purchasing commercial services and not developing government capabilities that compete with industry offerings. For both efficiency and economic development purposes, it is also important to leverage and use industry and/or voluntary consensus standards in areas like refueling, docking, and interfaces instead of developing bespoke requirements in government procurements.

Focus Issue: Conducting a National Active Debris Removal Mission

Relevant to:

The White House

Congress

National Aeronautics and Space Administration

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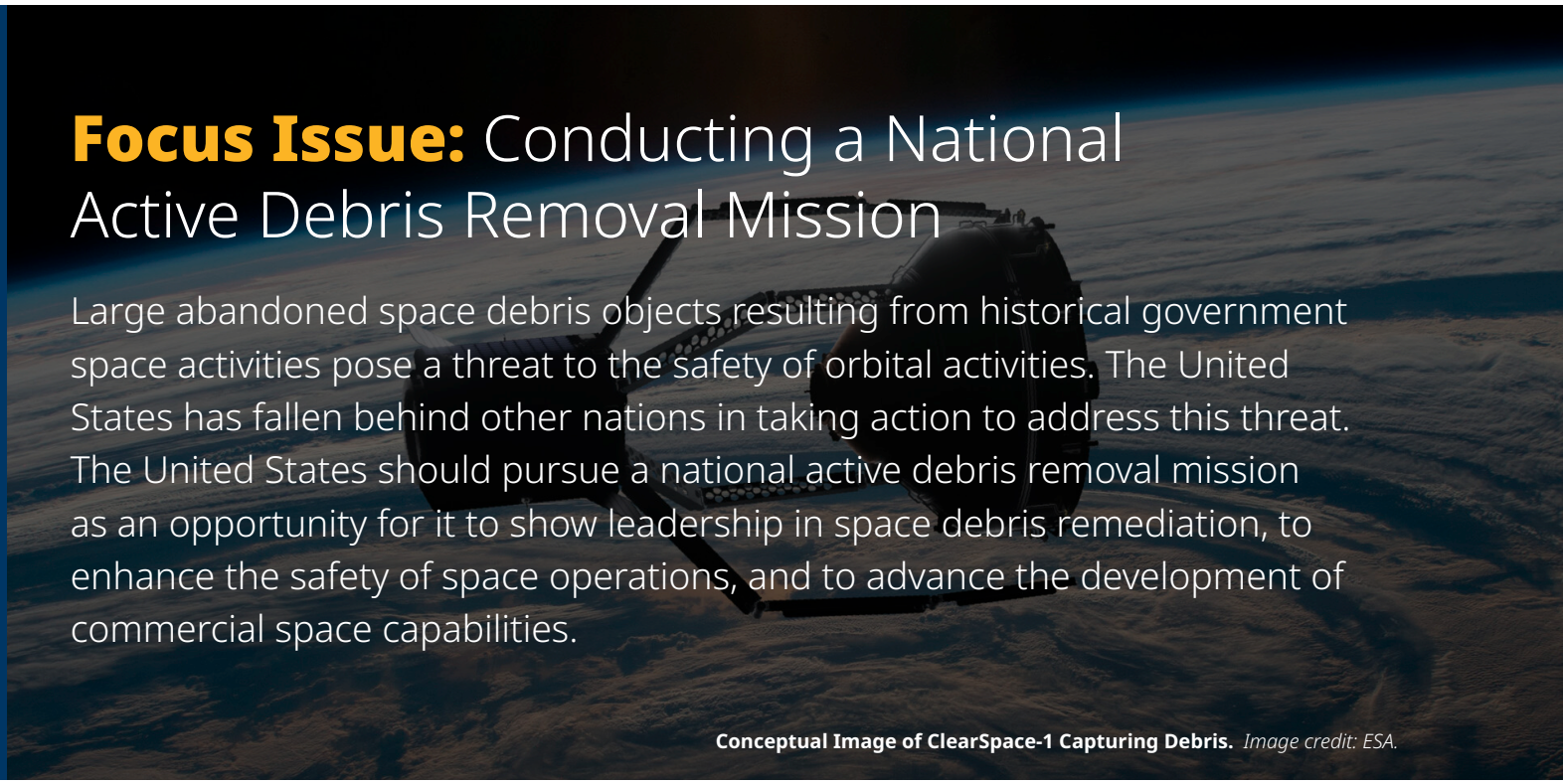

Focus Issue: Conducting a National Active Debris Removal Mission

Large abandoned space debris objects resulting from historical government space activities pose a threat to the safety of orbital activities. The United States has fallen behind other nations in taking action to address this threat. The United States should pursue a national active debris removal mission as an opportunity for it to show leadership in space debris remediation, to enhance the safety of space operations, and to advance the development of commercial space capabilities.

Conceptual Image of ClearSpace-1 Capturing Debris. *Image credit: ESA.*

Background

Maintaining and expanding national security, economic, and societal benefits that the United States derives from space services and capabilities depends on an operating environment that remains safe and conducive to continued operations. There are several risks to this stability, including the risk from collision between active spacecraft and space debris objects.

In particular regions of low Earth orbit (LEO), where historical activity has been high due to the economic and scientific utility of these orbits, there are a significant number of massive derelict space objects, primarily upper stages of rockets abandoned from prior space missions. For the most part, these large debris objects are part of the legacy of the past space activities of the United States, Russia (including historical Soviet objects), and China. These massive objects are uncontrolled and at risk of colliding or exploding—events that would foul these orbital regions with a large amount of debris, significantly increasing risks to operators in the environment. Action to remove these objects from orbit (e.g., active debris removal[ADR]) would provide stability and safety benefits to all actors in the space environment.

Active debris removal has been, and remains, a difficult technical, political, and business challenge to solve. There is no current commercial market for removing these objects and geopolitical considerations have limited government-to-government cooperation. Technical challenges associated with developing and maturing technology for the removal of unprepared debris objects (i.e., objects not designed for or actively participating in a removal operation, such as defunct rocket bodies or satellites) also have been a high barrier.

However, a number of trends and activities are reducing the technical challenges with debris remediation and ADR concepts. Development of adjacent capabilities, with potential commercial viability for in-space servicing, assembly, and manufacturing (ISAM) is helping to advance ADR-related technologies in commercially relevant rendezvous and proximity operations as well as in spacecraft grappling, berthing, and docking capabilities. Commercial space situational awareness

and space-to-space imaging capabilities and services enhance the ability to conduct characterization of debris objects and inform safe rendezvous operations. Further, companies are investing in novel debris remediation concepts, such as laser-based ablation and in-space recycling.

Most significant, however, are a number of ADR or debris remediation pilot and technology development programs underway in Europe, Japan, and the United Kingdom. The European Space Agency has funded the ClearSpace-1 mission which will remove the defunct European PROBA-1 satellite, with a target date in 2026. The United Kingdom Space Agency is funding the National Active Debris Removal Mission to remove a pair of defunct UK satellites, also planned in 2026. In Japan, the Japan Aerospace Exploration Agency (JAXA) has funded the Commercial Removal of Debris Demonstration (CRD2) program, which aims to cooperate with private Japanese companies to remove an unprepared Japanese upper-stage rocket body from LEO. Additionally, in January 2022, China's Shijian-21 spacecraft docked with and towed a defunct BeiDou navigation satellite to a graveyard orbit above geostationary orbit; as a capability demonstration. These capabilities advance national interest in these countries and support the development of industry capabilities, enhancing the competitiveness of their national space industry in the ISAM segment.

Current Policy and Gaps or Shortcomings

Notwithstanding the pilot and technology demonstration ADR missions described above, there is little public progress on large-scale debris remediation from the governments associated with the largest source risk from legacy objects (United States, China, and Russia). The United States has largely fallen behind other countries in both capability and action related to ADR capabilities.

Most of the pilot programs for debris remediation are in Europe, the United Kingdom, and Japan, although there have been a few other countries supporting minimal programs along these lines. In the United States, the Space Force's Orbital Prime program has awarded a number of small research and development contracts to U.S. firms for the development of ADR-related technologies, and the long-term objectives of the program include conducting an on-orbit demonstration of ADR. These programs are useful but have largely been limited to low-dollar studies of low-technology readiness level (TRL) concepts. It is important to advance the TRL of ADR concepts through hardware demos and on-orbit demos for civil space purposes.

Overall, the U.S. government has invested little in research and development (R&D) of remediation capabilities—despite high-level policy direction to do so—and currently lacks both follow-through on the existing implementation execution strategy and a broader vision to advance space debris remediation capabilities. In January 2021, the first Trump administration released the *National Orbital Debris Research and Development Plan*,[1] which sought to provide a coordinated plan to support research and development efforts related to orbital debris risk management across the federal government. In July 2022, the Biden administration issued the *National Orbital Debris Implementation Plan*, which sought to outline tangible implementation actions

1 National Science and Technology Council, National Orbital Debris Research and Development Plan (Washington, DC: Executive Office of the President, January 2021), https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/National-Orbital-Debris-RD-Plan-2021.pdf.

to build upon the 2021 R&D plan. Both plans have resulted in some increased activity in technology funding and studies, but only at a limited scale. There has also been bipartisan interest in Congress in enhancing national capabilities to conduct ADR missions. In September 2022, Senators Hickenlooper, Lummis, Cantwell, and Wicker introduced the Orbital Sustainability (ORBITS) Act, which would have established a program at NASA for actively removing debris from space, among other provisions. This bill was unanimously passed by the Senate in October 2023 but was not acted on by the House.[2]

The United States should pursue a national active debris removal mission as an opportunity for it to show leadership in space debris remediation.

Policy Recommendations

→ The U.S. government—through NASA—should establish a program to fund and conduct the removal of a U.S.-government-owned space debris object, preferably a large rocket body.

This mission should be conducted as a public-private partnership through NASA and would leverage existing NASA technical capability and investment related to ISAM, as well as emerging industry capabilities related to satellite servicing and in-space logistics. Such a mission would help to establish U.S. leadership in orbital debris remediation and set an example of responsibility in the importance of taking responsible action in support of the space economy. It would also deepen U.S. industry capabilities related to commercial markets in ISAM.

2 U.S. Congress, Senate, ORBITS Act of 2023, 118th Cong., 1st sess., introduced in Senate February 15, 2023, https://www.congress.gov/bill/118th-congress/senate-bill/447.

Strengthening Space and National Security

Relevant to:

The White House
Department of Defense
Department of State

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Strengthening Space and National Security

Growing reliance on space for U.S. national security and the proliferation of counterspace capabilities have increased concerns about how to protect and defend U.S. space capabilities. Current U.S. national security space policy focuses on increasing the resilience of space capabilities to deter attacks while also more closely integrating them with commercial and allied capabilities. The United States has also publicly declared space as a warfighting domain and embarked on a large-scale reorganization of military space capabilities with the creation of the U.S. Space Force and the re-establishment of U.S. Space Command. The United States should focus on how effective current resilience and reorganization efforts will be, as well as the role of offensive counterspace capabilities, norms of behavior, and space arms control.

Background

U.S. national security depends heavily on space capabilities. Space-based services such as satellite communications; positioning, navigation, and timing (PNT); and remote sensing are critical force enablers for the U.S. military. Many of these same services are key parts of the United States and the global economy. Space capabilities also provide nuclear command and control and strategic warning that are fundamental to strategic stability. As such, any significant disruption—or even the hint of it—could have serious consequences for national security, as well as societal and economic ripple effects.

Threats to space capabilities have changed over time. During the Cold War, although the threat of nuclear war deterred outright conflict in space, the United States and the Soviet Union developed both offensive and defensive capabilities. After the fall of the Soviet Union, the United States saw space as a potential "sanctuary"—free from serious hostile threats and optimized space capabilities for performance. Since 2010, the renewed development of offensive counterspace capabilities, particularly by China and Russia, has sparked new concerns about how to best protect U.S. space assets and deter attacks.

Two main strategies exist to deter attacks. One is deterrence by denying the benefits of attacks, which can be done by making space systems more resilient to attacks. The second is by deterrence by threat of force, which can be done by having offensive capabilities to be used against an adversary's capabilities, in space or elsewhere. Deterrence based on denying benefits of aggression presents

significant bureaucratic and technological challenges, while deterrence by threat needs to overcome the United States' much greater reliance on space than its adversaries. Also, deterrence by threat presents the risk of provoking other countries to mirror U.S. actions, leading to the classic security dilemma, where protective measures by one country are seen as intimidatory by others and lead to an escalating spiral of measures that are ultimately destabilizing.

International diplomacy is also a component of space security. Arms control in space has been a standard part of nearly every U.S. national space policy since the 1950s. The United States has played an active role in shaping global space governance to suit its national interests, including security, with the last major effort being the 1975 Registration Convention. While the 1967 Outer Space Treaty includes a ban on the placement of weapons of mass destruction in outer space, there are generally no specific restrictions on testing or deployment of conventional space weapons. Since the 1980s, there have been repeated UN resolutions aimed toward the prevention of an arms race in outer space (PAROS). Since 2008, Russia and China have proposed initiatives to ban the placement of weapons in outer space, but they have not gained wide international acceptance. Encouragingly, there has been a shift in the past five years at the multilateral level to focus on norms, rules, and principles of responsible behavior in space, resulting in some progress in terms of creating common understandings of what is responsible and irresponsible behavior. U.S. engagement and leadership in these discussions is crucial, lest U.S. adversaries step into the leadership vacuum.

Encouragingly, there has been a shift in the past five years at the multilateral level to focus on norms, rules, and principles of responsible behavior in space, resulting in some progress in terms of creating common understandings of what is responsible and irresponsible behavior.

Current Policy and Gaps or Shortcomings

The United States has had a long-running debate about how best to organize its national security space capabilities to meet potential threats. The debate had focused on whether space should have a separate military service or combatant command or be integrated into existing organizations, and whether military and intelligence space acquisitions and operations should be integrated or remain separated. In December 2018, President Trump signed a memo directing the Secretary of Defense to re-establish U.S. Space Command (USSPACECOM); it is in charge of day-to-day military space operations. In February 2019, President Trump signed the Space Policy Directive-4 (SPD-4), which called for the creation of a separate U.S. Space Force (USSF) within the Department of the Air Force to oversee the operate, train, and equip functions for military space activities. In December 2021, the Biden administration unveiled its Space Priorities Framework, which outlined efforts to strengthen stability in space and increase the resilience of U.S. space capabilities. In 2024, both the Department of Defense (DoD) and the USSF released commercial strategies in order to best utilize those capabilities to enhance military space resiliency and deter attacks. International partnerships are also being promoted as having similar results for the U.S. national security space enterprise.

Recently, in addition to focusing on improving the resiliency of U.S. military space programs, government officials and policy documents have increasingly acknowledged interest in and development of offensive counterspace capabilities. There has been a focus on what is being termed "responsible counterspace campaigning," which strives to achieve both offensive and defensive space operational needs while avoiding destruction of satellites that would create large amounts of orbital debris. In April 2022, the United States announced

its commitment not to conduct destructive direct-ascent anti-satellite (DA-ASAT) missile tests, largely because of the danger debris presents to all space actors, including the U.S. military and the U.S. space industry. In total, 38 countries[1] have since made this commitment, underlining the willingness of many countries to take official steps in order to mitigate this threat. The commercial sector is also wary of the danger that debris from these sorts of tests pose to their investment: as of January 2025, 52 companies from 16 countries (including 21 U.S. companies) have signed an industry statement of support[2] that SWF coordinated for the DA-ASAT missile test moratorium. Officials have also been discussing the need for "space fires," which refers to systems capable of attacking an adversary's space capabilities. This discussion of more offensive counterspace capabilities for the United States is being accompanied by an increased focus on understanding what is happening in the space domain (i.e., space situational awareness).

In February 2024, reports emerged about the existence of a new kind of Russian space-based anti-satellite (ASAT) program. U.S. officials have clarified that this capability is still in development and not yet deployed in orbit, but if done so, it would constitute a breach of the Outer Space Treaty. Although details still remain scarce, it appears the capability in question would utilize a nuclear weapon to generate an electromagnetic pulse (EMP) that could indiscriminately damage or disable large swaths of satellites. Last fall, the United States successfully led a UN General Assembly resolution urging Member States not to develop nuclear weapons or any other kinds of weapons of mass destruction specifically designed to be placed in outer space.

U.S. government agencies are also increasing their focus on resiliency and norms of behavior as a way to ensure continued access to and use of space. In July 2021, Secretary of Defense Austin released the first "Tenets of Responsible Behavior in Space," a set of norms that USSPACECOM would use to guide its military space operations. DoD released its Space Policy Review and Strategy of Protection of Satellites in September 2023, which noted, "In collaboration with the Department of State, the Department of Defense is committed to promoting standards and norms that ensure the domain remains secure, stable, and accessible."

This focus on norms of behavior has also been the center of U.S. efforts in multilateral fora discussing space security topics. Since the Eisenhower administration, U.S. national policy has largely supported space arms control discussions that were verifiable, equitable, and in the U.S. interest. The United States played a critical role in established arms control principles in the Outer Space Treaty and bilateral nuclear treaties during the Cold War. In recent decades, the United States has stepped back from support for legally binding initiatives, preferring to promote nonbinding agreements instead. Over the past five years, there have been international discussions on norms, rules, and principles of responsible behavior in space that have begun to yield results, in terms of actionable steps, to make space stable and predictable for all. ●

1 Secure World Foundation, "Multilateral Space Security Initiatives," last updated November 5, 2024, https://swfound.org/multilateral-space-security-initiatives/.

2 Secure World Foundation, "Space Industry Statement in Support of International Commitments to Not Conduct ASAT Tests," last updated March 3, 2025, https://swfound.org/industryasatstatement/.

Policy Recommendations

→ Refer to space as an "operational" domain rather than a "warfighting" domain.

By referring to space as a "warfighting" domain, the United States has handed its adversaries an easy diplomatic win by allowing them to use that phrasing as evidence that the United States is the one increasing tensions and weaponizing space. Referring to space as an operational domain would be an acknowledgment of how the military needs to continue to operate in and through space, would be in line with how others refer to it (including NATO), but would not hamper U.S. diplomatic efforts required to meet national security space concerns and goals.

→ Discourage the deliberate creation of debris.

The United States should maintain its current policy of committing not to conduct destructive DA-ASAT missile tests, as well as continuing to promote this during multilateral discussions in order to stigmatize this sort of testing and also encourage others to commit to this as an emerging international norm of responsible behavior in space.

→ Establish international norms of behavior for military space activities.

The United States should work with other countries to establish common understandings for what is considered responsible behavior in space, particularly for military activities that could cause misperceptions or increase tensions, such as rendezvous and proximity operations in orbit. The United States should use space situational awareness in order to help verify such actions.

→ Redouble efforts to improve resilience.

The United States needs to continue working to ensure the resiliency of its space assets via more responsive space launch, proliferated satellite architectures across multiple orbits and payloads, and more use of U.S. commercial capabilities, as well as the capabilities of U.S. allies.

Focus Issue: Continuing the Destructive DA-ASAT Missile Test Moratorium

Relevant to:

The White House
Department of Defense
Department of State
National Security Council

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Focus Issue: Continuing the Destructive DA-ASAT Missile Test Moratorium

In April 2022, the United States announced that it was making a commitment not to conduct destructive direct-ascent anti-satellite (DA-ASAT) missile tests and that it seeks to establish this as a new international norm for responsible behavior in space. To date, 37 other countries have also made this commitment. The destructive DA-ASAT missile test moratorium was made with the strong support of the Department of Defense (DoD) because space is a key national security enabler, and the deliberate creation of debris on orbit impedes the United States' ability to access and use its space capabilities. The United States should continue its support of this moratorium and encourage more countries to make this pledge.

An air-to-air left side view of an F-15 Eagle aircraft releasing an anti-satellite (ASAT) missile during a test in 1985. *Image credit: National Archive.*

Background

Destructive DA-ASAT missile tests have created some of the largest increases in space debris in the last two decades, are still resulting in problems for operational satellites today, and will make operating in low Earth orbit more dangerous for years to come. To date, four countries have held these tests: the United States, Russia, China, and India. Given the growing global reliance on satellites and space applications, many space actors perceive that responsible space behavior includes avoiding deliberately creating long-lived debris, such as the kind that results from a destructive DA-ASAT missile test. In April 2022, the United States became the first country to declare a commitment to no longer conduct destructive DA-ASAT missile tests. The United States' pledge was prompted in large part by the destructive DA-ASAT missile test conducted by Russia in November 2021, which created more than 1,800 pieces of trackable orbital debris. This declaration was soon followed by similar ones by many other countries. As of January 2025, 37 other countries have followed the United States' lead and made this declaration.[1]

There is no way to remove debris from destructive DA-ASAT missile tests from space and depending on the altitude of the interception, the debris can remain in orbit for years, if not decades to come. For example, China's January 2007 destructive DA-ASAT missile test created over 3,500 pieces of trackable debris, of which over 2,500 pieces are still in orbit 18 years later. This is not only an issue for government actors: the commercial sector is increasingly affected by interruptions to space security and stability caused by these debris-producing events. This concern can be seen in the industry statement of

1 Secure World Foundation, "Multilateral Space Security Initiatives," last updated November 5, 2024, https://swfound.org/multilateral-space-security-initiatives/.

support[2] for the DA-ASAT missile test moratorium that SWF coordinated and which, as of January 2025, has been signed by 54 companies from 17 countries (including 22 U.S. companies).

Destructive DA-ASAT missiles have limited military utility compared to other options. They are unlikely to be useful as weapons, given that they are immediately attributable (unlike other nondestructive counterspace capabilities, like jamming or cyberattacks) and the resulting debris makes the domain more difficult to operate for everyone, including the United States. Additionally, it should be clarified that the moratorium on testing does not prevent the development and even use of such weapons in an actual conflict, should the decision be made to do so. Debris is agnostic in terms of whose satellites it threatens: it does not matter if the country that held the test is a geopolitical ally or not. Furthermore, as more countries shift to proliferated satellite networks, the tactical benefit of taking out just one satellite in a broad network drops. These types of tests also can establish a precedent that these sorts of tests are acceptable and thus encourage more countries to conduct them. That in turn runs the risk of inadvertent escalation or even possible deliberate use of destructive ASAT weapons during a conflict if this proliferation becomes more prevalent. Finally, destructive DA-ASAT missile tests are a threat to human spaceflight. Debris from those tests pose a collision risk to the International Space Station (ISS) as well as future commercial space activities; in June 2022, the ISS had to maneuver in order to avoid debris from Russia's November 2021 test.

Current Policy and Gaps or Shortcomings

This commitment not to conduct destructive DA-ASAT missile tests is well in line with DoD thinking on the issue. It was foreshadowed in Secretary of Defense Lloyd Austin's July 2021 memo that spelled out five tenets of responsible behavior in DoD space operations, one of which was to "[l]imit the generation of long-lived debris." In January 2024, the U.S. Space Force's Chief of Space Operations, General Chance Saltzman, released his thoughts on how the Space Force should operate in a white paper titled, "Competitive Endurance, a proposed theory of success for the U.S. Space Force." One of the three core tenets is to "Undertake Responsible Counterspace Campaigning." In it, he warns that "if we find it necessary to destroy the adversary's space-enabled kill web and the result is a full-scale destructive conflict in space, the loss of satellites and resultant debris would destabilize the space domain in a way that endangers the space capabilities the Joint Force depends on for success." Therefore, he argues that "space forces must preserve U.S. advantages by campaigning through competition without incentivizing rivals to escalate to destructive military activities in space." Creating an international norm that regards destructive DA-ASAT missile tests as irresponsible behavior and discourages their usage serves this goal.

Moreover, the United States has been working in multilateral fora to both generate more support for the concept of a destructive DA-ASAT missile test moratorium and to encourage more countries to make this commitment not to conduct those types of tests. By establishing agreed-upon norms of behavior in space and generating restrictions on destructive DA-ASAT missile testing, the United States is able to work with the international community to delegitimize the testing of these weapons in orbit. The United States, along with partner nations, has been injecting this idea into multilateral discussions

2 Secure World Foundation, "Space Industry Statement in Support of International Commitments to Not Conduct ASAT Tests," last updated March 3, 2025, https://swfound.org/industryasatstatement/.

on responsible behavior in space, where it has seen a groundswell of support at the country level. Additionally, on December 12, 2022, the United Nations General Assembly adopted Resolution 77/41,[3] which called upon all States to commit not to conduct destructive DA-ASAT missile tests and to continue discussions in the relevant bodies to enhance space security. This is how global norms of behavior are established: have numerous countries indicate (through national commitments, voting on UN resolutions, incorporating them into international discussions of behavior that would strengthen space security) that they find this effort irresponsible and something truly against the international community's interest. ●

By establishing agreed-upon norms of behavior in space and generating restrictions on destructive DA-ASAT missile testing, the United States is able to work with the international community to delegitimize the testing of these weapons in orbit.

3 United Nations General Assembly, "Destructive Direct-Ascent Anti-Satellite Missile Testing," resolution adopted on 7 December 2022, A/RES/77/41, 12 December 2022, https://undocs.org/en/A/RES/77/41.

Policy Recommendations

→ Continue to support the destructive DA-ASAT missile test moratorium as a matter of U.S. policy.

The United States should continue to demonstrate leadership in norm-building by continuing to support the commitment not to conduct destructive DA-ASAT missile tests, both in terms of a policy that the United States will hold itself to and to promote more countries making this commitment themselves. The United States benefits from the stable, predictable space environment resulting from this moratorium.

→ Maintain a policy of not deliberately creating debris during military space activities and missions.

Deliberately creating debris on orbit will hamper the United States' ability to use and operate through space, ultimately harming U.S. national security. If the United States sets the precedent that this sort of action is acceptable, rival countries will follow, and ultimately the United States will comparatively suffer the most and thus be worse off than its adversaries.

→ Provide leadership in multilateral space security fora to shape norms of responsible behavior in space.

In April 2025, the United Nations is starting a four-year process of discussing issues related to space security called an "Open-ended working group on the prevention of an arms race in outer space in all its aspects." This is an excellent opportunity to generate momentum for international support of the idea that responsible space actors do not deliberately create debris on orbit through destructive DA-ASAT missile tests. Active participation in this forum would send a strong signal to the international community that the United States will continue to show leadership in being committed to the safety, security, stability, and long-term sustainability of space activities. Furthermore, it will provide a way to counter the influence of adversary nations in this forum; otherwise, in the absence of United States engagement and leadership, the discussions and outcome will be shaped to its adversaries' advantage.

Fostering Commercial Space with Efficient Policy and Oversight Tools

Relevant to:

The White House
Federal Aviation Administration
Federal Communications Commission
National Oceanic and Atmospheric Administration
Office of Space Commerce

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Fostering Commercial Space With Efficient Policy and Oversight Tools

Largely driven by U.S. companies and organizations, commercial space activity is in the midst of a worldwide expansion, including new actors, new application areas, and new business models. Governmental authorization and supervision of commercial space activities is not only a key duty of responsible space leadership, but it is fundamental for a robust and vibrant space economy by providing legal certainty to private sector entities and by setting the norms that support free and fair competition internationally. The United States needs a space policy approach that sustains this growth of commercial space activity and orients it for economic and societal benefit by considering appropriate oversight mechanisms, the government's role as a customer for commercial space firms, and policy measures to develop the space economy.

Background

The global space economy is estimated at around $570 billion as of the second quarter of 2024. Approximately one-fifth of that is government space program budgets, while the value of commercial space products, services, infrastructure, and supporting industry services is estimated at approximately $445 billion.[1] Traditionally, commercial space activities have largely been confined to satellite telecommunications services, a limited amount of commercial remote sensing activities, and a relatively small amount of commercial space launch services. Outside of those activities, most other space industry revenue is associated with government space programs as contractors or service providers. Many commercial space firms remain closely dependent on government programs.

Private sector space actors are introducing a range of new applications, services, and approaches to space activities. These include new direct-to-consumer and business-to-business services in remote sensing and communications; new in-space servicing assembly and manufacturing (ISAM) activities, including on-orbit satellite life extension and maintenance; interest in space resources utilization and lunar commercialization; and expanding activities in commercial human spaceflight and commercial LEO destinations.

These new business models and applications are attracting notable amounts of venture and private capital. Analysts estimated that in 2022, space start-ups attracted $8 billion in investment capital, down from a record $15.4 billion in 2021. Much of this activity is centered upon the United States—more

1 Space Foundation, "The Space Report 2024 Edition," The Space Report, accessed July 18, 2024, https://www.thespacereport.org/.

than 70 percent of the investment in 2022 went into American companies. The United States also represents the largest base of investment sources—in 2022, 47 percent of investors in space-related start-ups were based in the United States. The U.S. share (by number of investors) has remained essentially constant since 2018, with China being the next most significant source of both capital and individual investors.[2]

As private sector space activity becomes more prevalent, the pace of activity, the increasing number of actors, and the introduction of new services/applications challenge the continuity and safety of operations in the domain. A key aspect of space sustainability is the reality that the actions of one actor in the space domain can affect the ability of others to operate safely. Effective policy and regulatory practices for commercial space development should consider the role of sustainability and stability in enabling continued growth of the space economy.

Current Policy and Gaps or Shortcomings

The United States government must balance both industry promotion functions and oversight functions. Several agencies have both a regulatory role and an industry promotion role (e.g., the FAA's Office of Commercial Space Transportation, the Department of Commerce); others have an independent role that must consider both space and terrestrial industry needs (e.g., the Federal Communications Commission); while still other agencies play an important role as both a customer of the space industry and a developer of space technology (e.g., NASA, the Department of Defense). Agencies, including the Department of Commerce and the Department of State, also administer export control requirements that affect commercial space activities. The overall structure for commercial space-related policy implementation and regulation in the United States is fragmented.

Additionally, as commercial space activities increase in number and complexity, the ability of licensing agencies to keep pace with the increasing number of applications has been challenged. Budgets, staffing, and capacity of oversight authorities have not kept pace with the amount of activity. In order for regulators to operate effectively, appropriate resourcing must be provided, and processes must be adapted to enhance efficiency while still ensuring obligations are upheld and public and operator interests in safety and sustainability are met.

Recognizing these challenges, there has been considerable effort made since the Obama administration, including work in both the first Trump administration and the Biden administration, to conduct regulatory reform efforts within commercial space. These include recent reforms to export control restrictions on space and satellite-related items; efforts to reform Part 450 launch licensing at the FAA to enhance efficiency; revisions to non-Earth imaging, rapid revisit, and synthetic aperture radar licensing restrictions on NOAA to enhance U.S. industry competitiveness, and the creation of streamlined licensing processes for certain categories of satellites at the FCC. While these efforts have made progress, certain challenges remain, including further updates and consistency in orbital debris mitigation requirements, effective licensing processes for large constellations, and continuing reform of commercial remote sensing licensing.

Most significantly, however, despite these regulatory reform efforts, there is still the unanswered question of how to authorize and supervise private sector space activities that do not clearly fall under the existing authorities of NOAA, the FAA, or the FCC. While regulators overlap in some areas, there is a clear absence of authority in other areas. Neither

2 BryceTech, "Start-Up Space 2023," BryceTech, accessed February 8, 2025, https://brycetech.com/reports/report-documents/Bryce_Start_Up_Space_2023.pdf.

the FAA nor the Department of Commerce currently has authority to license on-orbit activities. This gap prevents commercial actors from knowing which regulator to approach for permission to undertake advanced, pioneering activities on orbit or on a celestial body. It increases costs to operators who must consult multiple agencies and creates uncertainty through a lack of consistency in licensing provisions. It has also led to concerns over agencies asserting authority over areas of activity that are potentially outside of their scope. Closing this gap is an opportunity to enhance the efficiency of government operations while increasing predictability and certainty for commercial operators.

The United States has a long-standing policy goal of "encouraging and facilitating the continued growth of a domestic commercial space sector."[3] There are opportunities to enhance outcomes in achieving this policy goal. In particular, commercial space-related procurement strategies used across the government are inconsistent and unevenly applied. In many cases, criteria used for decisions about purchasing commercial capabilities versus pursuing traditional development approaches are opaque at best Furthermore, the government can play a critical role in advancing early space-related technology to commercially relevant levels of maturity, yet the early-stage technology programs within the government's space-related agencies are often ineffective and, in particular, lack strategies to advance beyond the proof of concept stage to the validation and demonstration stages (where a commercial transition is more likely to occur).

The United States is not alone in efforts to develop a domestic commercial space sector. Countries around the globe have similarly initiated policy efforts focused on commercial space strategy, including in China, across Europe, Japan, and elsewhere. Commercial space will be both an area of economic cooperation and trade and an area of competition. Given this trend, it is important to continue efforts (which were initiated under the first Trump administration) to systematically track the economic size and return of the space sector, as a specific sector of the broader economy, in order to help set realistic policy goals and track their outcomes. Additionally, diplomatic efforts related to the space sector must consider commercial space activities as part of the overall approach to space-related foreign policy. ●

As private sector space activity becomes more prevalent, the pace of activity, the increasing number of actors, and the introduction of new services/ applications challenge the continuity and safety of operations in the domain.

3 Office of Space Commerce, "National Space Policy," U.S. Department of Commerce, accessed February 8, 2025, https://www.space.commerce.gov/policy/national-space-policy/.

Policy Recommendations

→ The Office of Space Commerce (OSC) within the Department of Commerce should act as the lead agency for the authorization and supervision of private sector space activities.

A clear and certain oversight process should be implemented with one agency designated as a lead to close the gap in licensing of commercial space operations and ensure consistency across the U.S. government. This agency should be the Office of Space Commerce (OSC) within the Department of Commerce and should be elevated out of NOAA to an office within the Office of the Secretary of Commerce. Making OSC the lead agency will complement its developing role of providing civil space situational awareness data and services to support spaceflight safety as it works towards developing a future space traffic coordination system.

→ Implement mission authorization through an interagency process, with OSC as the lead.

Acting as the lead agency for the authorization and supervision of private sector space activities, OSC should serve as a clearinghouse or tracking point for private sector space activities seeking government approval. This will provide more clarity for commercial companies who may not otherwise know who to go to in the U.S. government for a license and also help OSC better understand the breadth and scope of private sector space activities to inform its mission to promote such activities. For further discussion of mission authorization, please refer to the focus section.

→ Ensure licensing authorities are resourced at levels to ensure responsiveness.

Efforts to reform regulatory provisions to enhance the competitiveness of the U.S. space industry must be complemented by ensuring that licensing authorities have the appropriate amount of budgetary and staffing resources to respond to applications and issue licenses in an efficient manner. This should include retaining the Space Bureau at FCC, which has made progress in enhancing the responsiveness of that agency to satellite industry activities.

→ Establish an international dialogue on oversight of commercial space.

In order to improve the linkages between commercial space and foreign and trade policy, the U.S. government should pursue an active strategy of diplomatic and civil society dialogue on international approaches to commercial space sector policy, including with competitor nations. Such an approach will help to identify and share regulatory best practices, reduce the risk of regulatory fragmentation and forum shopping, and potentially help to identify trade opportunities for U.S. companies. It will help to ensure that the United States is at the forefront of establishing the values that define economic competition in the space market.

Ensuring Operational Continuity and Safety through Space Situational Awareness and Space Traffic Coordination

Relevant to:

The White House

Department of Defense

Office of Space Commerce

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Ensuring Operational Continuity and Safety through Space Situational Awareness and Space Traffic Coordination

Space situational awareness (SSA) and space traffic coordination (STC) are critical for protecting satellites, enabling mission continuity in space, and ensuring both safety and long-term stability in use of space. SSA is the ability to accurately characterize the space environment and activities in space and is the foundation of nearly all civil, commercial, and national security space activities. The United States needs to continue to support STC systems (both nationally and internationally) in order to protect stability in the space environment and ensure operational continuity and safety for operators.

Background

Space situational awareness (SSA) is the ability to accurately characterize the space environment and activities in space. Civil SSA combines positional information on the trajectory of objects in orbit (mainly using optical telescopes and radars) with information on space weather. Military and national security SSA applications (often referred to as space domain awareness) also include characterizing objects in space, their capabilities and limitations, and potential threats. SSA is an inherently international and cooperative venture. It requires a network of globally distributed sensors as well as data sharing between satellite owner-operators and sensor networks. SSA also forms the foundation of space sustainability as it enables safe and efficient space operations and promotes stability by reducing mishaps, misperceptions, and mistrust.

SSA has historically been done by the military for national security reasons, with secondary missions to protect important civil space missions such as human spaceflight. The United States military operates a network of ground- and space-based optical telescopes and ground-based radars that provide the bulk of our current knowledge about the space environment and human activities there. The military tracking capabilities are augmented by space weather measurements from scientific and meteorological satellites operated by civil agencies as well as the military.

The 18th Space Defense Squadron maintains a catalog of the orbital trajectories of more than 47,000 space objects (as of January 27, 2025) which is used to perform a variety of analyses to support commercial and civil spaceflight safety along with military and intelligence applications. These services include providing conjunction assessment warnings to all satellite operators as part of the Space Situational Awareness information-sharing program. The United States has negotiated a significant number of data-sharing agreements with more than 185 commercial sector, academic, foreign government partners, and intergovernmental organizations.

The United States is also in the midst of establishing a civil STC system operated by the Department of Commerce, under Space Policy Directive-3 (issued by the first Trump administration in 2018 and maintained by the Biden administration). Under this policy, the Office of Space Commerce (OSC) will be responsible for space safety information and services for public safety (including commercial space operators), while the Department of Defense will continue to maintain the authoritative catalog of space objects. OSC is developing the Traffic Coordination System for Space (TraCSS) to provide SSA services to civil and private space operators. In September 2024, TraCSS entered service for the first time, covering an initial set of users operating around 1,000 satellites.

Russia, China, and the European Union also have significant SSA capabilities, while many other countries are developing their own—albeit more limited—national capabilities. Private sector SSA services and analysis is a growing segment, particularly in the United States and Europe. In fact, some commercial actors are developing and fielding significant SSA capabilities that, in some cases, meet or exceed those of governments. Commercial SSA data is used to support and augment government catalogs and to provide services in support of public space traffic coordination services under development in governments, such as TraCSS. Services are also provided to spacecraft operators to augment their own satellite positional data and to support conjunction avoidance efforts, including automated collision avoidance systems being developed by large constellation operators. Commercial SSA data is also a key enabler for novel in-space activities, such as satellite servicing and active debris removal. National security agencies may also use commercial SSA data to augment analytical capabilities for intelligence purposes.

Broadly speaking, space traffic coordination (STC) refers to systems and practices, encompassing SSA information, data sharing, and possibly operational guidelines, that seek to reduce the potential for collisions and other incidents in space that could create safety risks for space activities. STC seeks to increase the safety and efficiency of space activities. A near-term focus of STC is detecting and avoiding collisions between active satellites and other space objects but also includes a broader array of policy and operational tools to provide oversight and management of space activities. STC is inherently international in nature as it involves coordination between all operators in the space environment, regardless of their national domicile.

Current Policy and Gaps or Shortcomings

The growth in commercial, civil, and international space activities and the overall number of satellites has stretched the current military-led SSA framework to the breaking point. Further, recent events such as the February 2022 loss of 38 Starlink satellites due to space weather highlight the important connection between space weather and orbital trajectory predictions. The proliferation of low Earth orbit (LEO) and very low LEO with large constellations makes space weather modeling and forecasting an acute challenge.

In 2010, the Obama administration began an interagency policy discussion on space traffic management (STM) which concluded that the portion of the SSA mission related to the safety of spaceflight activities should be transferred from the Department of Defense (DoD) to a civil federal agency, and leaned towards giving it to the Department of Transportation. In 2018, the first Trump administration issued Space Policy Directive-3 (SPD-3), the first national policy on STM, which assigned the responsibility for civil SSA and a future STM regime to the Department of Commerce. The Biden administration continued these efforts, with the OSC advancing the TraCSS program to initial operations, though further policy and budgetary support is needed to continue this program.

A key issue is how the federal government interacts with the private sector on SSA. The DoD's reliance on traditional defense contractors for developing its SSA capabilities has shut out new commercial entrants that are innovating faster and could provide lower-cost services. At the same time, the current model of providing free SSA data and services to all satellite operators from taxpayer-funded sensors has hindered the ability of those same commercial providers to find private sector customers and investment. SSA information services also support a critical public safety function, supporting safe space activities for a wide range of U.S. (and international) space operators. Shifting to a purely private sector model for providing SSA data and services risks shutting out academic, scientific, not-for-profit, and other users who cannot afford to pay for access. Achieving an appropriate balance between public and private roles in SSA data and services provision is an ongoing challenge. ●

The growth in commercial, civil, and international space activities and the overall number of satellites has stretched the current military-led SSA framework to the breaking point.

Policy Recommendations

→ Maintain efforts to implement SPD-3 and TraCSS.

Since the finalization and publication of SPD-3, the OSC has made steady progress on implementing a civil space traffic coordination system. As TraCSS continues to transition from initial operations to its planned full-scale service, it is of great importance to ensure continuity in this program and work across the administration and Congress to provide full funding for the Office of Space Commerce to implement TraCSS. A civil STC system is a key enabler of maintaining the United States' leadership in growing the space economy, supporting continuity and safety of operations by commercial space actors (as well as other users of the space environment). Transitioning this function from the DoD to the Office of Space Commerce also promotes efficiency by enabling DoD to focus its SSA efforts on fulfilling its national security missions.

→ Lead International Efforts Towards Space Traffic Coordination.

As large satellite constellations are deployed, led in large part by U.S. operators, the need to have processes, practices, and methods in place to share basic space safety information, in order to protect operational continuity and maintain stability in the operating environment, increases. U.S. operators will need to ensure that space safety information can be exchanged with operators from other jurisdictions. With the existing operational expertise of its operators, its existing base of SSA sensors and data, and the deployment of the TraCSS system, the United States is positioned to lead international efforts to establish these basic coordination practices. The United States should proactively engage in international conversations to develop STC mechanisms, which might be voluntary in nature, including working closely with allied efforts, such as the EU Space Surveillance and Tracking (EU SST) program, to ensure an efficient and effective coordination network emerges that supports U.S. interests and a stable environment conducive to the long-term growth of space activities.

→ Leverage commercial capabilities to the maximum extent while also supporting SSA as a public good.

Both the DoD and OSC TraCSS should purchase commercial SSA data and services and pursue international data-sharing agreements in lieu of building new government capabilities. This will promote efficiency, support industry development, and allow the DoD to prioritize existing national sensor networks to support national security needs. The United States should also make basic space safety information services as publicly and freely available as possible. The private sector should be incentivized to develop innovative analytical tools and advanced services based both on public services as well as the data collected by commercial firms.

Focus Issue: Implementing Mission Authorization

Relevant to:

The White House
Congress
Department of Transportation
Federal Aviation Administration
National Oceanic and Atmospheric Administration
Office of Commercial Space Transportation
Office of Space Commerce

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Focus Issue: Implementing Mission Authorization

In the United States, a patchwork of agencies share responsibility for licensing and overseeing commercial space activities. As commercial space activities continue to expand in scope, this patchwork leads to gaps and inefficiencies in the current oversight framework to enable novel commercial space activities. A concept known as "mission authorization" has been suggested to address these gaps and inefficiencies. It is in the interests of the United States, and the development of the U.S. space industry to implement a mission authorization framework, led by the Office of Space Commerce.

The U.S. at night, from space. *Image credit: NASA.*

Background

The United States implements its oversight of private sector space activities through a series of licensing authorities. The Federal Aviation Authority's Office of Commercial Space Transportation (FAA/AST) licenses all commercial space launch activities and performs a limited review of payloads headed to outer space during launch. It also licenses re-entry of commercial spacecraft. If a spacecraft will be taking pictures of the Earth, a remote sensing license is also required from the National Oceanic and Atmospheric Administration (NOAA). The Federal Communications Commission (FCC) licenses all commercial use of radio frequencies, an essential capability in all space communications.

The commercial space sector is in the midst of an expansion in scope and capabilities, including new actors, new application areas, and new business models. Examples include in-space servicing, assembly, and manufacturing (ISAM) activities; commercial lunar activities; and commercial space stations and low Earth orbit (LEO) destinations. Many of these novel capabilities and services do not clearly align with these existing licensing and oversight practices, which have primarily been designed for space launch, satellite communications, and commercial remote sensing. This leads to inefficiencies in processing and gaps in authority and legal certainty for commercial space operators. Addressing these shortcomings has been a policy goal of several U.S. presidential administrations and has been a need supported by a significant portion of the U.S. commercial space industry.

In 2016, the Obama administration proposed a concept called "mission authorization," which would provide a process for licensing novel commercial space activities in response to a Congressional request to address this gap. Mission authorization was subsequently endorsed by the first Trump administration as part of the 2020 National Space Policy and assigned to the Department of Commerce

(DOC). However, neither the Obama nor the first Trump administrations developed the specifics of how to implement mission authorization. During the Biden administration, the National Space Council developed a proposal for implementing mission authorization, building on elements proposed by both the Obama and the first Trump administrations. The House of Representatives also introduced a different proposed approach to implementing licensing for novel commercial space activities. Neither proposal was enacted.

Current Policy and Gaps or Shortcomings

The continued gap around licensing and oversight of novel space activities creates uncertainty for private sector operators and leads to inefficiency in government processes. It is in the interests of the United States and the development of its space industry to implement a mission authorization process that provides clarity to novel commercial space activities while also ensuring norms and oversight practices are established to protect and promote stability and safety in the operating domain on which these businesses rely.

The current lack of clarity around licensing practices for novel commercial space activities poses a number of challenges to the development of the U.S. space industry.

"This regulatory uncertainty poses risks to investor and market confidence, as well as introduces possible delays into business plan timelines."

These include:

- Some commercial space activities require multiple licenses from different agencies; **operators may have to approach multiple regulatory agencies**, creating administrative and cost burdens for those commercial operators, particularly for new operators.
- While regulators overlap in some areas, **there is a clear absence of authority in other areas**. This gap prevents commercial actors from knowing which regulator to approach for permission to undertake advanced, pioneering activities on orbit or on a celestial body. This regulatory uncertainty poses risks to investor and market confidence, as well as introduces possible delays into business plan timelines.
- As commercial space activities increase in number and complexity, the ability of regulatory agencies to keep pace with the increasing number of applications is being challenged. **Budgets, staffing, and capacity of regulatory authorities have not kept pace with the amount of activity.** This lack of resources creates inefficient processes and has a direct negative impact on enabling commercial activity. In order for regulators to operate effectively and efficiently, appropriate resourcing must be provided.

Implementation of a mission authorization framework is of key importance to addressing these challenges. ●

Policy Recommendations

→ Implement mission authorization through an interagency process, with OSC as the lead.

Acting as the lead agency for the authorization and supervision of private sector space activities, OSC should serve as a clearinghouse or tracking point for private sector space activities seeking government approval. This will provide more clarity for commercial companies who may not otherwise know who to go to in the U.S. government for a license and also help OSC better understand the breadth and scope of private sector space activities to inform its mission to promote such activities.

→ The OSC should act as the lead agency for the authorization and supervision of private sector space activities.

A clear and certain oversight process should be implemented with one agency designated as a lead to close the gap in licensing of commercial space operations and ensure consistency across the U.S. government. This agency should be the OSC within the Department of Commerce and should be elevated out of NOAA to an office within the Office of the Secretary of Commerce. To make this process as effective as possible, the following elements should be included:

- For all activities not covered under existing authorities at FCC/FAA/NOAA, OSC should serve as the interface point for licensee applicants for tracking applications and processing times. A clear timeline should be established for licensing processes, and the OSC should be the point of contact for applicants seeking updates on the expected processing timelines for their applications. Where interagency coordination is required in the licensing process, this clearinghouse function would provide administrative support for that coordination and serve as a single point of information for applicants. Establishing OSC as such a clearinghouse would improve the competitiveness of the U.S. space industry by reducing the challenges companies face in identifying and interfacing with the appropriate licensing authorities.

- Mission authorization should apply to the mission conducted by a spacecraft over its lifetime as a whole (as opposed to requiring separate approvals or processes for each individual part of a mission). It would effectively serve as a "license to operate" within certain pre-approved parameters, that are defined in the initial license.

- In the interests of promoting a safe operating environment for all commercial space businesses, licensing conditions should ensure that basic space safety requirements are met (including registration with SSA service providers and compliance with space debris mitigation guidelines) and should seek to ensure uniformity in application of these requirements to all operators of the same type of mission. Such uniformity is essential to ensure individual operators are not unfairly advantaged or disadvantaged by the authorization process. Licenses should be based on a presumption of approval, with the burden on the government to describe rationale for denial, in such cases. Attention should be given to long-term externalities of the licensing decisions.

Leveraging a Whole-of-Government Approach to Drive Space Policy Leadership

Relevant to:

The White House

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Leveraging a Whole-of-Government Approach to Drive Space Policy Leadership

Creating a national space policy needs to be a whole-of-government process that integrates perspectives, capabilities, and interests from across the federal government. Since the 1950s, every U.S. administration has had an interagency process for creating national space policy, although in many cases, it was not a separate or unique process solely for outer space issues. In 2016, the Trump administration revived the National Space Council (NSpC) to formalize a separate space policy process and raise its visibility within the federal bureaucracy and the public. An executive branch-level coordination forum for space policy, like the NSpC, can ensure that perspectives, capabilities, and interests from across the federal government are coordinated within the space policy process.

Background

Understanding how, and why, governments choose a course of action on an issue is one of the enduring problems in public policy and public administration. Policy decisions on dual-use technology, such as those involved in many space activities, are particularly challenging as they require balancing the national security aspects with the potential societal and economic benefits. Additionally, as space activities and use of space-derived services have expanded in recent decades, the number of federal entities with a role in space policy has also increased, driving the need for efficiency in inter-agency coordination. There is a need for a mechanism at the federal level that brings together multiple different agencies and departments to deliberate, debate, and set U.S. national policy on how space capabilities are developed and used.

The National Space Council (NSpC) could be such a mechanism. The Council was established by Congress during the transition to the George H.W. Bush administration as a reorganization of the then-dormant National Aeronautics and Space Council. Chaired by the Vice President, the NSpC is typically composed of Cabinet-level agencies with roles related to space. Subsequent administrations decided not to staff or use the NSpC, preferring instead to use the National Security Council (NSC) or National Science and Technology Council (NSTC) run by the Office of Science and Technology Policy (OSTP) as the top-level interagency coordination body for space policy. The first Trump administration revived the NSpC by staffing it, using it to coordinate a set of national space policy decisions, and holding periodic public meetings to discuss space policy issues. The Biden administration maintained the NSpC and its staffed office.

Current Policy and Gaps or Shortcomings

In particular, during the first Trump administration, the revived NSpC has largely been successful in establishing an efficient mechanism for discussing, debating, and finalizing national space policy. During the first Trump administration, the NSpC held eight formal meetings, whereas only three formal meetings were held during the Biden administration. Key achievements of the NSpC during the first Trump administration included issuing four major space policy decisions (supported by formal space policy directive documents) that reestablished the Moon as the near-term human spaceflight goal, directed an overhaul of the regulatory framework for oversight of U.S. commercial space activities, established the first-ever U.S. national policy on space traffic management, and laid the foundation for the establishment of the U.S. Space Force. During the Biden administration, the NSpC and its staff played a key role in developing recommendations for oversight of novel commercial space activities, coordinating and publishing the December 2021 United States Space Priorities Framework policy document and reforming space-related export control policies.

The National Space Council has been successful in increasing the political priority and public visibility of space policy, a key component of ensuring needed action on space sustainability challenges. Its function in providing an executive branch-wide coordination and decision forum, supported by dedicated personnel, for major space policy actions has helped create a whole-of-government approach to space policy. In the absence of an alternative executive branch mechanism for all-of-government coordination, the NSpC provides a model that has proven to be productive and successful under the previous Trump administration. Whatever modality is chosen, it is important that there be an effective executive branch-level coordination forum for space policy to continue to address pressing space policy needs across the government. ●

Given the increasing strategic and economic importance of the space sector, it is important to ensure there is a high-level coordination of federal policy for this domain.

Policy Recommendations

→ Keep an executive branch coordination mechanism for space policy, such as the National Space Council.

Given the increasing strategic and economic importance of the space sector, it is important to ensure there is a high-level coordination of federal policy for this domain. The NSpC, or another similar coordinating mechanism, should be implemented as the main body for developing national space policy and should be staffed with experts from inside and outside the U.S. government, specifically those who understand the interagency process and the importance of space. It would also be beneficial to consider ways to include the Federal Communications Commission in NSpC discussions, when relevant, to enhance the coordination of policy.

Supporting Multilateral Space Diplomacy

Relevant to:

The White House
Department of Commerce
Department of Defense
Department of State

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Supporting Multilateral Space Diplomacy

Space diplomacy and international cooperation are essential foreign policy tools to maintain U.S. leadership in space exploration and commercial space activities and to preserve the access to and use of outer space as a domain that the United States relies on for its prosperity and security. As more nations become spacefaring, and as more foreign commercial entities become space actors, the United States needs to strengthen its space diplomacy and international cooperation initiatives to provide leadership in promoting wide international adoption of norms, standards, and best practices to enhance the safety, stability, and security of space activities.

Background

In order to get continued benefits from and use of space, the United States has relied on space diplomacy as a way to achieve this goal, as well as reinforcing U.S. leadership—in space and on Earth. Historically, U.S. diplomatic efforts have played a major role in the formulation, promotion, and implementation of the international laws and norms that guide space activities. The United States has also used diplomacy to strengthen its relationship with key allies and partners, with mutual benefits. In both its multilateral and bilateral engagements, the United States has helped enshrine U.S. values in the current global space governance regime and shape the regime to benefit U.S. interests. By doing so, the United States has led the world in working towards a safe, stable, and sustainable space environment.

Over the last decade, U.S. diplomatic efforts have faced new challenges. The international landscape for space has become more complicated, with a growing number of countries with diverse interests and capacities becoming involved in space activities and governance discussions. There are new types of activities in space that go beyond what the traditional governance regime for space has covered. Commercial actors have become increasingly dominant in Earth orbit and are conducting missions to the Moon, necessitating discussions in terms of how principles in the Outer Space Treaty should be applied in new contexts and circumstances not envisaged when the Treaty was adopted in 1967. Very large constellations have spiraled the number of active satellites upwards, challenging space situational awareness capabilities and highlighting the increasing need for space traffic coordination (STC) to ensure the safety of space operations. The steady proliferation of space debris also poses a growing challenge for the management of the orbital

environment. At the same time, there is renewed competition from China and Russia, each of whom is pushing its own space activities and attempting to seize diplomatic initiatives to advance its own interests. Counterspace capabilities are proliferating globally, and multilateral discussions are striving to come to consensus on what constitutes responsible behavior in space. The United States has been using diplomatic outreach to generate support for the Artemis Accords—its vision for the principles guiding civil exploration and use of celestial bodies for peaceful purposes—and has been able to, as of January 2025, encourage 53 countries to sign the Accords. Further, discussions continue at the United Nations on how to implement guidelines for the long-term sustainability of space activities, a process that the United States led and has been able to use to shape these evolving space governance mechanisms for the benefit of all nations.

Current Policy and Gaps or Shortcomings

There are several gaps in current U.S. space diplomacy initiatives that the new administration needs to address. First, the United States needs to scope an effective way to shape international consensus on practices and standards that could lead to a future space traffic coordination regime. Second, the United States must enhance international adherence to existing measures mitigating the continued growth of orbital debris, which represents an ever-increasing threat to satellites and human spaceflight. Third, the United States should develop and promulgate practical and consistent international principles for oversight of new commercial space activities such as large constellations, rendezvous and proximity operations, small satellites, commercial space stations, space resources activities, and other classes of commercial space operations. Finally, allies' and adversaries' counterspace capabilities pose grave risks for the stability and safety of space operations and could directly impact civil and commercial space systems of all nations.

The Artemis Accords provide a valuable opportunity to use space exploration as a tool of diplomacy in support of the United States' objectives to promote the rule of law in space to ensure the safety, stability, and security of space activities.

The United States also needs to play a stronger role in improving the effectiveness of the fora for multilateral space diplomacy. The principal forum for multilateral civil space diplomacy, the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), has made many valuable contributions to the governance of space activities during the past half-century, with much of the progress made due to U.S. leadership. With the rapidly evolving space landscape, COPUOS has focused on space sustainability with fruitful results, but it needs a clear direction in terms of agenda-setting for productive discussions on cooperative governance of new kinds of space activities. COPUOS is at a critical juncture in terms of its role as the leading international body for the progressive development of cooperative space governance. The United States should continue to demonstrate strong leadership in international space diplomacy as a way of strengthening the rule of law in outer space. In the absence of U.S. leadership, adversary countries may leverage these fora to their advantage.

The Conference on Disarmament (CD), the principal multilateral disarmament forum, has discussed practical measures to promote space security, such as transparency and confidence-building measures for space activities, or other norms of responsible behavior, with some success. However, discussions on the prevention of an arms race in outer space have been much less productive and are deadlocked, while there is disagreement in terms of what the biggest threats to space security are and whether a legally binding approach is necessary (or even possible) to mitigate those threats. The United States has used some of these international discussions

to generate broad support for its commitment not to conduct destructive direct-ascent anti-satellite (DA-ASAT) missile tests. Thus, the United States is well placed to provide more prominent leadership in these forums to enhance the safety, security, and sustainability of space activities as well as U.S. national interests. It is important to note that China and Russia will continue to engage in these fora, and would most likely jump at the opportunity to fill a leadership hole, should the United States withdraw from these discussions. It is also unclear what effect the Trump administration's call for the United States to develop and deploy space-based interceptors for boost phase missile defense will have on these international discussions, but it is likely going to make maintaining U.S. leadership in these discussions more challenging. ●

Policy Recommendations

→ Work with and through multilateral fora to help shape international consensus on norms of behavior, standards, and practices to enhance the safety and sustainability of space activities.

As noted previously, the rapid increase in the number of spacefaring countries, the rise of commercial actors, and the proliferation of counterspace capabilities globally are transforming the outer space environment and posing numerous challenges for all space actors. The United States cannot address these developments on its own, as it requires international cooperation both to promulgate the behaviors and best practices to ensure long-term sustainability and security, but also just due to sheer physics, the activities of a single actor have the potential to affect everyone's ability to continue to utilize space. Therefore, the United States should continue to actively pursue the development of norms of responsible behavior and provide leadership in the development of international consensus standards and best practices to enhance the security, safety, and sustainability of space activities through engagement with the appropriate international and multilateral fora. One of the norms the United States should continue to promote is the decision not to conduct destructive DA-ASAT missile tests.

→ Harness its leadership in space exploration to preserve the stability, safety, and security of the space environment and to support multilateral efforts to improve cooperative space governance.

Given the increasing number and diversity of spacefaring nations, international cooperation is becoming ever more important to preserve the stability, safety, and security of the space environment. The Artemis Accords provide a valuable opportunity to use space exploration as a tool of diplomacy in support of the United States' objectives to promote the rule of law in space to ensure the safety, stability, and security of space activities. It also provides an opportunity to engage new, nontraditional partners in emerging space countries. In this regard, the United States should continue to seek new signatories for the Artemis Accords, provide more tangible ways to link Accords signatories to Artemis Program participation as a way of solidifying partnership relationships and benefits, and use the momentum generated from signatories' support of the U.S. goals and policies to translate that into support of U.S. goals for COPUOS.

→ Use the expertise of domestic commercial and other nongovernmental stakeholders to achieve its international space diplomacy goals.

In support of the United States' engagement in international multilateral space diplomacy, particularly with regard to negotiations that may have domestic regulatory implications, it is important to engage domestic stakeholders to obtain their input so that the United States can help to provide sound leadership in these multilateral fora to develop pragmatic and workable solutions that are aligned with established best practices. In addition, the United States should harness the expertise in the commercial, academic, and nonprofit sectors to support engagement in both formal and informal multilateral dialogues that help to build and sustain international connections, relationships, information sharing, and confidence building.

Engaging with China on Space Activities

Relevant to:

The White House
Department of Defense
Department of State
National Aeronautics and Space Administration

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Engaging with China on Space Activities

For the last several decades, the United States has been concerned about China's space programs and plans, in a dynamic which often reflects the larger U.S.–China relationship. There is no doubt that the United States and China are engaged in a geopolitically competitive relationship, but there is also no doubt that China is a major space actor across all dimensions of space activity and it cannot be ignored. In an attempt to "constrain" China's space program, the United States has put in place laws and policies that end up harming itself while doing little to impede China's progress in space. While recognizing that China is a competitor, the United States can still benefit from finding ways in which to engage with China to maintain stability in the space domain and to proactively promote responsible space activities.

Background

China's space program in many ways originated as a result of U.S. national security fears. The program was started by Qian Xuesen, who worked on space projects at CalTech in the 1950s until (unfounded) worries about him passing classified information to communists led to his security clearance being revoked and five years of house arrest. He subsequently emigrated to China and helped found their nuclear weapons and space programs. This set the tone for much of the way the United States has viewed China's space program: with great suspicion and responses that often exaggerated the threat while simultaneously creating the exact circumstances they were trying to prevent.

U.S. concerns about China's space program re-emerged in the late 1990s. After two launch failures of U.S. commercial satellites on Chinese rockets, U.S. companies provided technical information during the accident investigation that ended up improving the reliability of Chinese rockets for both space launch and ballistic missiles. In response, Congress imposed strict export controls on everything related to space. While these restrictions did not impede China's space program, they did harm the U.S. space industry, which lost significant global market share due to the rise of international competitors who were not hampered by similar export restrictions.

Today, China is engaged in a long-running effort to develop the full breadth of space capabilities for economic development, scientific research and exploration, human spaceflight, and national security uses. Two decades after being excluded from the International Space Station (ISS) program, China has developed its own robust human spaceflight capabilities, including operating a crewed space station with continuous crew presence since June 2022, and has plans to conduct crewed Moon landings beginning as soon as 2030. Under the International Lunar Research Station (ILRS) program, China has built a network of partners (including governments, companies, and universities) to participate in its lunar development plans, demonstrating diplomatic reach.[1] Since 2016, the Chinese government has made a number of policy and financial changes designed to develop and leverage commercial and private space capabilities, including remote sensing, launch, and satellite broadband constellations. U.S. policymakers have been concerned about how these industry capabilities relate to and integrate with the Chinese military and how they are leveraged in support of China's foreign policy objectives. Chinese companies began to launch satellites in their own large low Earth orbit (LEO) constellations intended to provide broadband internet capabilities, similar to SpaceX Starlink and Amazon Kuiper. Up to three Chinese constellations, with thousands of satellites in each, are planned. China has also developed its own space-based intelligence and reconnaissance capabilities and its version of the Global Positioning System called BeiDou, all of which have military applications. China is also developing a suite of offensive counterspace capabilities aimed at deterring and negating U.S. capabilities in a future conflict.

Current Policy and Gaps or Shortcomings

In 2011, Congress passed the Wolf Amendment, named after then-Representative Frank Wolf (R-Virg.), who was concerned about China's treatment of religious minorities and possible intellectual property theft via hacking. While it does not officially preclude U.S.–China bilateral cooperation in space, it requires the White House's Office of Science and Technology Policy, NASA, and the National Space Council to obtain certification by the Federal Bureau of Investigation (FBI) that no technical information with economic security or national security implications will be shared with China and that none of the entities involved have human rights violations; in addition, Congress and the FBI must be notified 30 days in advance of the activity. Although there is little evidence that the Wolf Amendment has achieved its goals or affected China's domestic policies, it has given Chinese officials a pretext to deflect criticisms about its lack of transparency or engagement onto the United States.

The Obama administration started two sets of bilateral exchanges with China, one on space safety and one on security. Space was also included in iterations of the bilateral Economic and Security Dialogue. The first Trump administration initially attempted to continue these dialogues, although no formal meetings were ultimately held. There was no continued engagement on these bilateral exchanges during the Biden administration.

Much of the U.S. national security space enterprise has stoked concerns about China's lunar plans, often to the detriment of redirecting attention away from more pressing threats. The landing sites under consideration in China's lunar program are in similar locations to sites under consideration in the U.S.-led Artemis Program (driven by similar technical, scientific, and economic motivations). Much of the public analysis in the United States of China's

1 Secure World Foundation, "Lunar Space Cooperation Initiatives," last updated January 23, 2025, https://swfound.org/lunar-space-cooperation-initiatives/.

lunar programs focuses on potential competition and threats to the United States, rather than on the technical, diplomatic, and scientific drivers (and challenges) informing China's programmatic decisions.

Both China's increasing deployment of large satellite constellations and its lunar ambitions have raised coordination and safety concerns within industry and other space stakeholders. As U.S. satellite operators deploy and operate their own satellite constellations, the risk of potential collisions with Chinese operators is growing because the Chinese systems deploy through existing constellations and operate in orbits similar to existing systems. Bilateral sharing of information and coordination for basic operational safety is limited, and there is a need to improve engagement around space safety practices. U.S. operators —and those from other partner countries—have established coordination and transparency practices amongst themselves; they are looking for options to exchange information with Chinese operators to do the same and thus formalize norms shaping space safety. On the Moon, concerns about the ability to respond in a timely manner to human safety issues, understanding of intent, and shared hazards of lunar dust, among other concerns, drive perceived need for coordination channels.

Multilateral space security discussions have pitted the United States (and like-minded nations) against China and Russia in terms of identifying what the biggest threat is to space security and whether the best way to mitigate that threat is through legally binding instruments or nonbinding voluntary norms of behavior. For nearly two decades, China and Russia have been promoting a treaty to prevent the placement of weapons in space; the United States has taken the position that it is much more effective to focus on norms, rules, and principles of responsible behavior aimed at making the space domain more stable, predictable, and reliable to access and use.

By isolating China from existing multilateral cooperative efforts in space like the ISS, the United States has pushed China to launch its own space station. Furthermore, this forced separation has allowed China to use its space program to create its own relationships with countries the United States has long deprioritized, particularly in Latin America and Africa. This has resulted in soft power advantages for China that have shown benefits in trade and diplomatic discussions. ●

Establishing channels for information sharing and promoting space safety practices can act to reduce the potential for misunderstanding that might lead to conflict while promoting stability in the operating domain that will support growth in space activities.

Policy Recommendations

→ Reassess the Wolf Amendment to allow for limited space engagement with China.

Working with the Trump administration, Congress should review and revise the implementation of the Wolf Amendment to increase NASA's engagement in space activities with China that support U.S. national interests. Priority areas for engagement include basic space science and research, robotic space exploration, human spaceflight safety, lunar search and rescue, and increased data sharing on space weather and orbital debris.

→ Expand space safety dialogue with Chinese actors.

The United States and China have shared interests in ensuring basic operational safety in the space environment, including both in LEO and in cislunar space (including the lunar surface). Establishing channels for information sharing and promoting space safety practices can act to reduce the potential for misunderstanding that might lead to conflict while promoting stability in the operating domain that will support growth in space activities. This is particularly important in the context of national space traffic management and/or coordination initiatives. Dialogue of this type might be pursued in several ways, including: bilateral government-to-government discussions; informal civil society dialogues; and engagement in multilateral fora such as the proposed Consultative Mechanism on Lunar Activities at UN COPUOS.

→ Increase understanding of the Chinese space sector.

Congress should work with the Trump administration to fund and carry out studies that systematically document and understand the structure and nature of the Chinese space ecosystem, how the industry is structured, the true relationships between the central government, the state-owned enterprises, and the private companies, the role of the provincial governments, how private capital operates in the Chinese space sector and how all of this relates to the space program priorities of the Chinese government.

Ensuring U.S. Leadership in Space Exploration and Development

Relevant to:

The White House
Department of Commerce
Department of Defense
Department of State
National Aeronautics and Space Administration

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Ensuring U.S. Leadership in Space Exploration and Development

The exploration and use of space has now developed beyond just space exploration and into the industrial and economic development of the Moon, Mars, and other celestial bodies. This raises national security, economic, legal, and policy questions—particularly about how to best position the United States for leadership, foster American prosperity, and lead in the development of international rules for prosperous and sustainable space exploration and development. The Administration should reaffirm its commitment to the Artemis program and U.S. leadership in returning humans to the Moon, work towards the adoption of the Artemis Accords, and engage in international discussions on space resources.

Background

International government and commercial interest in lunar presence, exploration, and utilization has increased in recent years. Five countries have successfully landed on the Moon: the United States, Russia, China, India, and Japan; additionally, last year brought about the first successful landing by a commercial actor. As of March 2025, the United States, India, China, and South Korea are operating active lunar missions, and at least nine countries have planned lunar missions[1] over the next decade.[2]

China aims to put humans on the surface of the Moon by 2030. In April 2024, the China Manned Space Engineering Office (CMSEO) announced that China remains on track to achieve this goal,[3] and in June 2021, China and Russia announced the International Lunar Research Station (ILRS), which consists of both a lunar exploration program and a set of principles for activities undertaken as part of that program.

In 2017, the Trump administration directed the National Aeronautics and Space Administration (NASA) to develop and enact the Artemis Program to

1 Planetary Society, "Every Moon Mission, Ever", https://www.planetary.org/space-missions/every-moon-mission.

2 C. Swope and L. Gleason, Salmon Swimming Upstream: Charting a Course in Cislunar Space (Washington, DC: Center for Strategic and International Studies, October 21, 2024), https://www.csis.org/analysis/salmon-swimming-upstream-charting-course-cislunar-space.

3 A. Jones, "China on Track for Crewed Moon Landing by 2030, Space Official Says", SpaceNews, April 24 2024, https://spacenews.com/china-on-track-for-crewed-moon-landing-by-2030-space-official-says/

return an American crew to the Moon.[4] [5] However, in December 2024, NASA announced that it would need to delay both—respectively, to April 2026 and mid-2027, due to problems with the Orion crew spacecraft and its heat shield.[6] Artemis would follow that landing up with a sustained human lunar presence through subsequent missions to both lunar bases and an orbiting gateway. NASA has begun procuring commercial and industry contributions to Artemis, including human landing systems and assorted robotic precursor missions. Although led by the United States, Artemis would be executed in cooperation with a range of international partners, including Canada, Japan, and several European states.[7] For example, one of the three primary components of NASA's Orion spacecraft, the service module, will be provided by the European Space Agency and Airbus Space.[8]

Sustained human presence in space and on the Moon will require the use of resources found in space to support crew life and function. A major focus of near-term lunar exploration will be to verify the extent and usability of these resources. The United States, China, and India all have planned missions that would land near the Moon's south pole because of this interest in possible sources of water. Lunar regolith itself may prove to be useful for building lunar structures and habitats, while other lunar resources may have scientific, exploration, and commercial utility.

However, some uncertainty exists around the legal framework that would enable rational and sustainable space resource activities. The Outer Space Treaty, of which the United States led in the negotiation and drafting, makes national territorial annexation over celestial bodies and parts thereof legally impossible. The Treaty also states that all celestial bodies are free for exploration and use by all. Multilateral discussions on the topic since 2016 have trended towards the position that space resource utilization is permitted, but these discussions have raised several questions over how that activity should be regulated, coordinated, and executed in a stable manner.

The United States lacks a consolidated strategy or coordination function for lunar activities. Commercial activities on the Moon do not have a clear regulatory structure and fall into the same gap in authorities and ad hoc licensing as many other nontraditional commercial space activities.

An increased tempo of activity on and around the Moon raises several governance and policy challenges. Measures must be developed to protect that while enabling future activities and use. As more operators function on the surface and in lunar orbit, there is an emerging need to develop space situational awareness (SSA) and space traffic coordination capabilities specifically for cislunar space. NASA and the International Committee on Global Navigation Satellite Systems (ICG) have

4 NASA, Artemis, https://www.nasa.gov/feature/artemis/.

5 A. Donaldson, "NASA Shares Progress Toward Early Artemis Moon Missions with Crew", NASA, January 9, 2024, https://www.nasa.gov/news-release/nasa-shares-progress-toward-early-artemis-moon-missions-with-crew/.

6 A. Jones, "NASA Delays Artemis Missions Again. What Could this Mean for the Moon, Mars and Space Leadership?", Space.com, December 23, 2024, https://www.space.com/space-exploration/artemis/nasa-delays-artemis-missions-again-what-could-this-mean-for-the-moon-mars-and-space-leadership.

7 Government of Canada, The Artemis Program: Humanity's Return to the Moon, last updated December 6, 2024, https://www.asc-csa.gc.ca/eng/astronomy/moon-exploration/artemis-missions.asp; NASA, "NASA, Japan Advance Space Cooperation, Sign Agreement for Lunar Rover", April 10, 2024, https://www.nasa.gov/news-release/nasa-japan-advance-space-cooperation-sign-agreement-for-lunar-rover/.

8 NASA, European Service Module, https://www.nasa.gov/humans-in-space/orion-spacecraft/european-service-module/; NASA, NASA, European Space Agency Formalize Artemis Gateway Partnership, https://www.nasa.gov/news-release/nasa-european-space-agency-formalize-artemis-gateway-partnership/

begun opening doorways to communication and transparency on these issues with other lunar actors.

There are also national security concerns about cislunar activities. National space security strategists in both the United States and China have referred to the lunar environment as the "ultimate high ground." It is possible that the Moon may become a place for geopolitical competition, specifically between the United States and China, and military conflict may arise as a result.

Current Policy and Gaps or Shortcomings

The United States lacks a consolidated strategy or coordination function for lunar activities. Commercial activities on the Moon do not have a clear regulatory structure and fall into the same gap in authorities and ad hoc licensing as many other nontraditional commercial space activities. Cislunar domain awareness is only just beginning to emerge as a serious element of national security space strategy.

Space resource activities raise several legal and regulatory challenges that are not adequately addressed through current policy and law. There is no mechanism for assignment and international recognition of priority or access rights to resources, nor are there means for deconfliction over potential competition for access to specific resource sites on the Moon or asteroids. Efforts to develop regulatory specificity should proceed in an adaptive, incremental manner which encourages innovation and private sector investment in a space resources economy. Addressing these issues will require both domestic and international discussion. In this context, the United Nations has recently established an Action Team on Lunar Activities Coordination (ATLAC) to initially focus on information sharing and deconfliction amongst lunar actors. Meanwhile, another working group at the United Nations has been developing legal principles on the exploitation and use of space resources, and will likely circulate these draft principles to UN Member States in the first half of 2025.[9]

The first Trump administration initiated the Artemis Accords, a nonbinding political commitment to allow for sustainable space exploration. Through the Accords, the United States seeks to secure commitments from other countries to follow several principles related to lunar (and other space) activities and interpret their implementation in a specific way. These principles cover a range of topics, including space resources utilization, safety zones, heritage site protection, and interoperability. As of January 2025, the Artemis Accords have 53 state signatories. However, some of these Artemis Accords signatory states have questioned what their actual engagement and involvement in the Artemis Accords will be, and what signing gets them. In addition to seeking new states to sign the Artemis Accords, efforts should be made to coordinate and engage with existing members, including with options and opportunities in the Artemis program. ●

9 United Nations Office for Outer Space Affairs, Working Group on Legal Aspects of Space Resource Activities, March 2024, https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/space-resources/index.html.

Policy Recommendations

→ Sustain commitment to the Artemis program.

The Administration should reaffirm its commitment to the Artemis program and U.S. leadership in lunar exploration. Technologically, the Moon is the gateway to Mars, and many international arrangements have been made under the Artemis program and Artemis Accords—the reneging of which would harm U.S. space leadership and space diplomacy. The Administration should work with Congress to establish bipartisan support for a sustained crewed lunar exploration program that serves as the cornerstone of further space exploration and development.

→ Continue to work with the international community to implement the Artemis Accords.

The principles of the Artemis Accords represent a practical approach forward to addressing several cislunar governance issues. Efforts should be made to continue to work towards the adoption of these Accords, including engagement with possible competitor nations. In addition to seeking new countries to sign the Artemis Accords, efforts should be made to coordinate and engage with existing members, including with options and opportunities in the Artemis program.

→ Continue multilateral engagement on space resources governance.

The United States should continue to positively engage in discussions at the United Nations Committee on the Peaceful Uses of Outer Space and other multilateral fora to develop consensus principles to enable space resources activities. These principles can complement U.S.-led approaches like the Artemis Accords and serve a coordinating function.

→ Employ the U.S. Space Force to support increased cislunar situational awareness.

While the United States should continue to observe its international legal obligations not to put military installations on the Moon or conduct military maneuvers there, there remains a role for the U.S. military to continue to help enhance cislunar situational awareness as a matter of spaceflight safety for the increased number of lunar missions.[10]

10 Air Force Research Lab, "AFRL's Oracle Developing Nation's 1st Cislunar Space Situational Awareness Capabilities", December 11, 2023, https://afresearchlab.com/news/afrls-oracle-family-of-systems-developing-nations-1st-cislunar-space-situational-awareness-capabilities.

Improving U.S. Space Weather Capabilities

Relevant to:

Department of Commerce

National Aeronautics and Space Administration

National Oceanic and Atmospheric Administration

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Improving U.S. Space Weather Capabilities

Space weather is a natural threat to critical infrastructure in space and on Earth, and it affects the sustainable use of space. Executive branch efforts during the Obama and the first Trump administrations sought to better organize and task space weather-related federal entities to prepare and protect against disruptive space weather phenomena by augmenting research and operational forecasting capabilities, as well as establishing plans for response and recovery. These efforts have resulted in concrete suggestions by the Space Weather Advisory Group. To ensure continued advancement in anticipating and mitigating dangerous space weather effects, key legislation should be passed, executive branch collaboration should be continued, and nascent commercial space weather efforts should be supported.

Background

During the Sun's roughly 11-year sunspot cycle, activity ebbs and flows as the solar magnetic field changes orientation from north to south, or vice versa; 2020 marked the beginning of a new cycle as the Sun came out of a period of low activity, or a solar minimum. Since then, the activity has been building up to the next solar maximum in July 2025. Minimum and maximum differ by activity and are measured in numbers of sunspots and other active regions on the surface of the visible Sun. Sunspots are areas of high magnetic activity where the Sun's magnetic field lines become entangled and give rise to solar flares and coronal mass ejections (CMEs) when these tangled magnetic fields explosively realign. A CME is an immense cloud of charged particles hurled into space from the surface of the sun in a particular direction, sometimes toward Earth. When a CME arrives at Earth, it can produce a geomagnetic storm that can cause anomalies and disruptions to satellites, paralyze power grids on the ground, and confuse GPS equipment.

Additionally, solar activity expands and contracts the Earth's atmosphere during the solar cycle. The outer layers of the atmosphere interact with satellites to increase or decrease drag, which shortens orbital lifetimes but also throws off orbital propagation models used for predicting the future location of objects—both of which affect space situational awareness

Federal Efforts

Different entities within the U.S. government have been studying space weather for over 75 years. Well-documented incidents of extreme space weather during World War II, the Vietnam War,[1] and the Cold War[2] drew the attention of the military more broadly, as these events increased geopolitical tensions. Civil government research into space weather phenomena was spread across multiple executive branch agencies studying different portions of the Earth-Sun interactions. This bifurcated military/civil approach, compounded by further branching on the civil side, has prevented a whole-of-government approach for better understanding and mitigating the risks of extreme space weather.

Following roughly 20 years of on-again, off-again intragovernmental coordination,[3] the current version of executive branch space weather activities was solidified in 2015 with the Obama administration's *Space Weather Strategy and Action Plan*.[4] The Strategy and Action Plan laid out the structure and vision for the Space Weather Operations, Research, and Mitigation (SWORM) Task Force within the National Science and Technology Council. Including principals from multiple departments, agencies, and the Executive Office of the President, the SWORM laid out high-level strategic goals and plans to achieve them. The Trump administration maintained relative continuity and, in fact, updated the Strategy and Action Plan in March 2019.

The strategies were revisited and realigned across three overarching objectives:

1. *Enhance the protection of national security, homeland security, and commercial assets and operations against the effects of space weather;*
2. *Develop and disseminate accurate and timely space weather characterization and forecasts; and*
3. *Establish plans and procedures for responding to and recovering from space weather events.*

Between 2017 and 2020, different versions of authorizing legislation related to government space weather activities have been introduced to the 115th and 116th Congresses.[5] These bipartisan bills were reconciled across chambers in the 116th Congress, and the Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow Act (PROSWIFT Act) was passed by both chambers and signed into law in October 2020. The PROSWIFT Act largely codified the work of the SWORM Act into authorizing legislation and suggested some additional specific appropriations. These efforts ensure that the executive branch agencies continue to collaborate to address space weather research and preparedness while maintaining continuity. Since then, Congressional appropriations have partially supported the maintenance and modernization of satellites used for space-weather forecasting. In addition, the Infrastructure Investment and Jobs Act provided authorizations and appropriations that could be used to support space weather resilience, among many other purposes.

1 Knipp et al., "On the Little-Known Consequences of the 4 August 1972 Ultra-Fast Coronal Mass Ejecta: Facts, Commentary, and Call to Action", *Space Weather Journal*, AGU, 2018.

2 Knipp et al., "The May 1967 great storm and radio disruption event: Extreme space weather and extraordinary responses", *Space Weather Journal*, AGU, 2016.

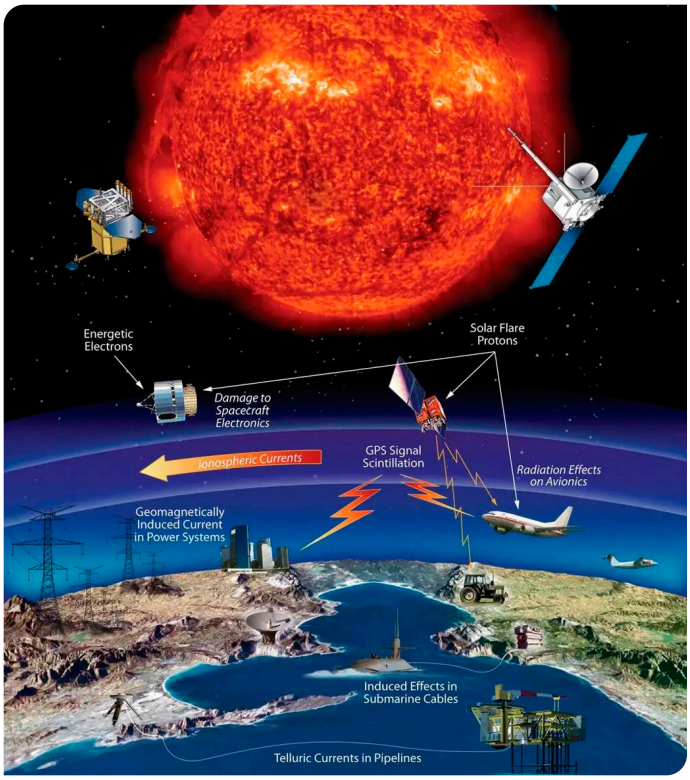
3 Bonadonna, Lanzerotti, & Stailey, "The National Space Weather Program: Two decades of interagency partnerships and accomplishments", *Space Weather Journal* , AGU, 2016.

4 Executive Office of the President of the United States, *National Space Weather Strategy and Action Plan* (Washington, DC: Executive Office of the President, March 2019), https://trumpwhitehouse.archives.gov/wp-content/uploads/2019/03/National-Space-Weather-Strategy-and-Action-Plan-2019.pdf.

5 H.R. 5260, PROSWIFT Act; S.881, Space Weather Research and Forecasting Act, 2020.

In December 2023, the White House Office of Science and Technology Policy (OSTP) released the Implementation Plan of the National Space Weather Strategy and Action Plan, which incorporated Congressional action under the PROSWIFT Act and seeks to serve as a roadmap for coordinated interagency efforts. It aims to enhance U.S. preparedness for and mitigation of space weather events by improving forecasting capabilities, protecting critical infrastructure, and coordinating across government agencies and the private sector.

Under the auspices of the PROSWIFT Act, the National Oceanic and Atmospheric Administration (NOAA), working with SWORM, established the Space Weather Advisory Group (SWAG). This group was tasked with providing recommendations for implementing the PROSWIFT Act and transforming the National Space Weather Enterprise (released April 2023) and with conducting a comprehensive user survey (released in September 2024).



Current Policy and Gaps or Shortcomings

The entities of the U.S. government that are focused on space weather are headed in the right direction. However, there is a danger that these gains could be shortlived; furthermore, there are emerging areas that require additional action. For instance, space weather research is a key challenge to the government-led human space exploration agenda, as dangerous levels of radiation remain a challenge for long-duration crewed space missions on the Moon, Mars, or en route to either. For instance, in between Apollo 16 and 17, a radiation storm struck the Earth-Moon system that would have killed any astronaut outside of the Earth's magnetic field. Today, private recreational spaceflight, from companies like Virgin Galactic, Blue Origin, and SpaceX, also face the radiation challenge; however, in this case, it would not just affect government workers but also private citizens. Outside of the human-related challenges, space situational awareness (SSA), which refers to the tracking and cataloging of space objects orbiting Earth, relies heavily on space weather models that are needed to make accurate predictions of orbital motion in near-Earth orbits, which is essential for space traffic coordination. As the low Earth orbit (LEO) satellite population balloons in the coming years, better SSA will require much more precise understanding and forecasting capabilities from the space weather community.

Some of these priorities include long-term support for continuity of critical operational observations, the development of new observations, and fundamental science necessary to advance space weather research. These need to be linked through a functional and funded research-to-operations process. ●

Figure 04 | Technological infrastructure affected by space weather events include satellites, aircraft, and power grids. A web of inter-dependencies makes the modern economy especially sensitive to solar storms. This is why advancing the understanding of the causes of space weather and improving its forecasting are critical goals. *Credit: NASA*

Policy Recommendations

→ Maintain whole-of-government focus across administrations and with support from Congress.

When the space weather-focused agencies of the executive branch work in tandem with the authorizing and appropriating committees in Congress, it can result in more effective policy. For consistency across presidential administrations and continuity of purpose for missions, the implementation of PROSWIFT Act and the accompanying recommendations made by the SWAG should guide the executive agencies. This includes ensuring adequate funding is made available for implementation.

→ Ensure continued data collection sources through the protection of space-, ground-, and air-based sensors.

The United States' solar observing satellites and other space weather observation infrastructure are aging, and unexpected failures could lead to gaps in data collection. As we go further into Solar Cycle 25, the erosion of capabilities across the solar observation fleet will only increase. In order to maintain data collection to advance monitoring and forecasting of extreme space weather, a pipeline of new space- and ground-based observing systems must be initiated.

→ Work with international partners to augment observations and research.

Similar to capacity in space exploration and R&D budgets, the United States spends the largest amount of money on space weather-focused science across the world. Yet, regional monitoring and capacity are necessary to better understand and mitigate the effects of space weather on localities around the world, ultimately also protecting U.S. assets and interests. U.S. leadership in these efforts can build global capacity and can work to augment capabilities rather than duplicate efforts.

→ Support the development of commercial space weather services.

Satellite companies, hardware manufacturers, researchers with operational concepts, and others are in the nascent stages of developing a commercial space weather enterprise. A delineation of what information and baselines the U.S. government will provide will go a long way to providing a stable innovation space for companies, while ensuring that commercial products meet the needs of U.S. space weather priorities.

Maximizing Value from Earth Observation Systems

Relevant to:

The White House

National Aeronautics and Space Administration

National Oceanic and Atmospheric Administration

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Maximizing Value from Earth Observation Systems

Monitoring the Earth and its environment from space contributes positively to scientific, social, economic, and political activities on Earth. It provides policymakers with the ability to better understand ongoing and sudden occurrences and thereby leads to more informed decision-making. Earth observation data and derived information and applications allow us to monitor and forecast weather conditions, measure land-use change such as deforestation, and monitor and respond to natural disasters. The United States needs to ensure continuity of service by developing both national and commercial capabilities, continuing to improve the commercial licensing processes, and championing open and free data-sharing principles.

Background

In the more than five decades since the first satellite was launched, space-based remote sensing, defined as the scanning of Earth by satellites in order to obtain information about it, has transformed from a small set of military-driven satellites producing low-resolution images to thousands of government, commercial, and academic satellites producing a huge variety of datasets for civil, research, and military purposes. This technology and associated applications improve life on Earth in innumerable ways. For instance, Earth observation satellites allow us to assess the impacts of natural disasters, monitor land use, make weather predictions, measure ocean temperatures, and create nautical charts. Data is used to conduct supply chain monitoring, support precision agriculture and aquaculture, and support building and other infrastructure projects.

For decades, the United States has been the clear leader in designing, manufacturing, and operating remote sensing satellite systems. One example is the Geostationary Operational Environmental Satellite (GOES) series of satellites. A joint effort of NASA and the National Oceanic and Atmospheric Administration (NOAA) beginning in 1975, the GOES series of spacecraft helps meteorologists observe and predict local weather events, including thunderstorms, tornadoes, fog, hurricanes, flash floods, and other severe weather. Also, in the 1970s, NASA and the U.S. Geological Survey (USGS) launched the Landsat program, which provides the longest continuous space-based record of Earth's land in existence and contributes to a better understanding of agriculture management, assessing regeneration of tropical forests, tracking forest fire damage, and other changes to land cover and use. These are just two examples of the cutting-edge and critical Earth observation technology supported by NASA,

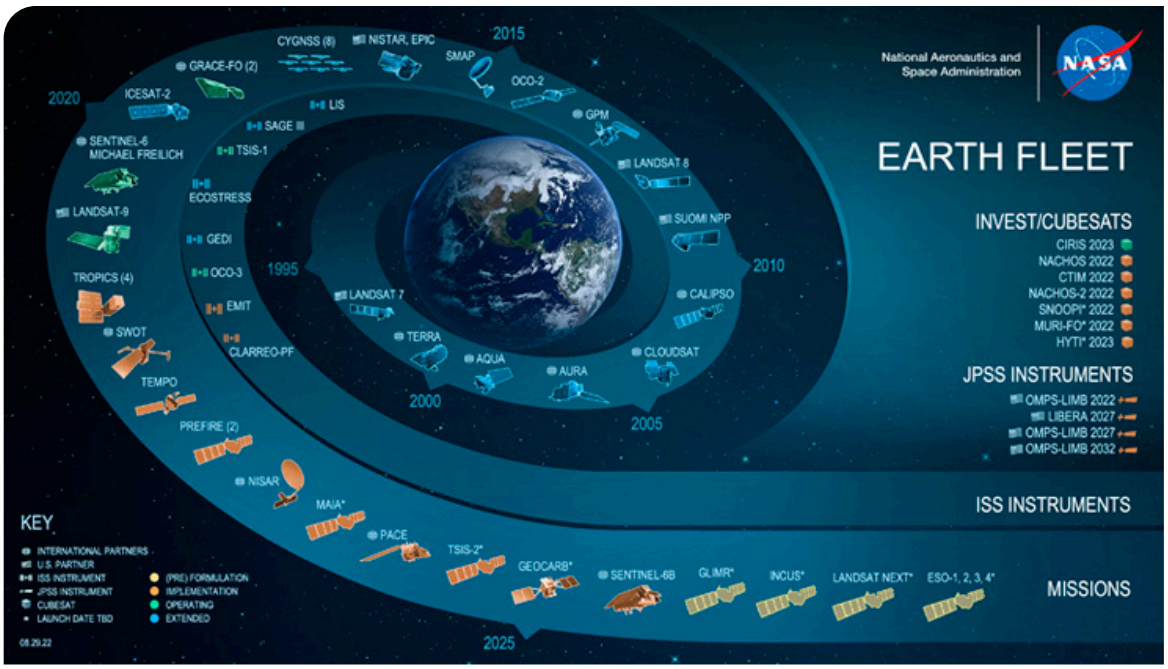

Figure 05 | NASA Earth Science Division Missions. *Credit: NASA*

NOAA, USGS, the National Geospatial-Intelligence Agency (NGA), and the Department of Defense (DoD). Many other countries have also developed their own capabilities. Fueled by a changing regulatory landscape, improved launch capabilities, and innovations in manufacturing, recent years have also seen an explosion of commercial Earth observation capabilities, including a growing array of optical, radar, hyperspectral, and video imagery and data.

Current Policy and Gaps or Shortcomings

Recognizing the importance of maintaining critical public services, enabling new discoveries, and advancing knowledge, the United States has sustained strong political support to ensure the continuity of service for meteorological-related satellites. Land-observing systems, equally important for the nation, have received less consistent study, funding, and coordination. The United States Group on Earth Observations, a subcommittee under the National Science and Technology Council, is made up of a number of relevant federal agencies and serves as the forum for coordinating, planning, and assessing nation's civil Earth Observations Enterprise (EOE) and for finding ways to improve Earth system data management and interoperability throughout the government. This group has released a series of plans designed to to ensure greater coordination of the research, operations, and activities relating to civilian Earth observation. The most recent, the 2024 National Plan for Civil Earth Observations,[1] builds on the 2019 version and focuses on the following goals:

1. *Improve the integration of Earth observing services across federal agencies and the broader Earth Observation Enterprise,*
2. *Ensure integrity and long-term quality of EO data across the EOE, and*
3. *Ensure the continued availability of foundational U.S. government capabilities in EO, while expanding the use of commercial data and services.*

1 United States Group on Earth Observations, "2024 National Plan for Civil Earth Observations," December 2024, https://usgeo.gov/uploads/USGEO-National-Plan-2024.pdf

Under multiple recent administrations, the United States has maintained as a core principle that Earth observation data are public goods, paid for by the American people, and that free, full, and open access to these data significantly enhances their value. As more commercial data sources are becoming available and purchased by the government to augment public data, the government needs to ensure that federal programs do not compete with commercial markets/products, while also maintaining critical public good datasets as free and open. Commercial activities serve to complement government satellites and offer new analytic capabilities for aggregate or service providers to generate new information for better decision-making. Currently, government agencies are more academic and research-focused: the U.S. government builds and funds big, exquisite satellites and allows anyone to access the data. To date, there are many unexplored possible partnerships with technology and other firms for hosting, interpreting, and using data that represent opportunities for Americans to receive even more value from the satellites they are funding.

Earth observation data and derived information and applications allow us to monitor and forecast weather conditions, measure land-use change such as deforestation, and monitor and respond to natural disasters.

Additionally, the government has recently taken strong action to support the development of a competitive American remote sensing industry. Rule changes, such as those to Licensing of Private Remote Sensing Space Systems, have simplified and updated regulations in order to allow American businesses to compete in the global arena at a faster pace. More recent regulatory changes streamlined satellite export controls, allowing for commercial opportunities for U.S.-based Earth observation companies. The current focus is now on implementing these rule changes and determining further needed adjustments, creating processes for licensing of non-traditional satellite operations, and on assessing the need for supportive legislation that would update the Land Remote Sensing Policy Act of 1992, which is the most recent piece of legislative guidance on this issue. ●

Policy Recommendations

→ Support continuity of service for all Earth-observing satellite capabilities and continue to champion free and open data-sharing principles.

The U.S. government should remain committed through policy and funding to having an appropriate pipeline of essential meteorological satellites and should extend the same commitment to continuity of coverage for land observing systems. Further, the government should continue to adhere to the core principle of free and open by supporting technology and best practices designed to improve data discoverability and usability.

→ Enable commercial sector value-added services and promote a thriving American commercial remote sensing industry.

The U.S. government should include expanding public-private partnerships to increase the use and value of Earth observation data that is already being produced. The government should also continue to improve the regulatory environment for U.S. companies by ensuring that implementation of recent rule changes is carried out swiftly and with clear guidance. Industry and other stakeholders should be fully consulted to ensure that any additional oversight and licensing rules are updated as needs evolve. A further update of older legislation, such as the Land Remote Sensing Policy Act of 1992, may also be required to accomplish this.

Leading on Global Planetary Defense Efforts

Relevant to:

The White House
Department of Homeland Security
Department of State
National Aeronautics and Space Administration
Federal Emergency Management Agency

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Leading on Global Planetary Defense Efforts

The threat of a devastating asteroid or comet strike somewhere on Earth's surface is perhaps the ultimate "low probability, high impact" event. Large asteroid strikes are rare over short time spans, but over the long term, they are essentially inevitable. As the potential for damage and devastation is large, the sustained expenditure of time and resources towards asteroid or comet strike detection, forecasting, and mitigation and response efforts is warranted. The United States should continue to lead cooperative global efforts in searching for potentially hazardous objects and for planetary defense preparation.

Background

Near-Earth Objects (NEOs) are defined as any object coming within 30 million miles of the surface of the Earth.[1] NEOs are usually solid objects from the main asteroid belt (between Mars and Jupiter), but can also be comets originating in the outer solar system which head towards the Sun. The entire population of NEOs is large,[2] but it is only the larger, *potentially hazardous NEOs* (a subset of the entire NEO population) that warrant action.

In 2005, Congress directed the National Aeronautics and Space Administration (NASA) by 2020 to find and characterize 90 percent of the predicted population of NEOs 140 meters in size or larger, which would threaten national and regional catastrophic damage if they were to strike the Earth. NASA estimates there may be as many as 25,000 such NEOs. As of March 2025, NASA has only detected about 44 percent of these objects and estimates that it will take until 2050 to accomplish the task. This shortfall is mainly due to limited funding and technology: finding and cataloging all of the remaining predicted NEOs of this size requires space-based telescopes, which can observe the sky without blurring from Earth's atmosphere, allowing them to detect fainter, darker asteroids, especially those near the Sun, which are obscured in its glare when viewed from the ground.

Current Policy and Gaps or Shortcomings

Defending the Earth from space-borne catastrophes enjoys broad bipartisan support, as well as interest—and concern—from the general public. There are essentially two main activities in planetary defense:

1 For comparison, the Moon is about 238,000 miles away from the Earth.

2 NASA Jet Propulsion Laboratory, "All Known Asteroids in the Solar System (1999-2018)", YouTube, July 23, 2018, https://www.youtube.com/watch?v=vfvo-Ujb_qk.

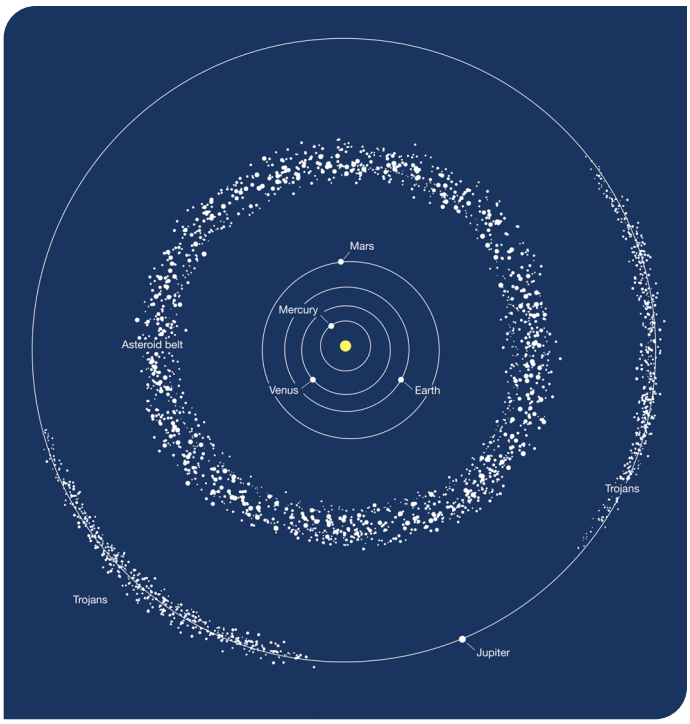

Figure 06 | This image depicts the two areas where most of the asteroids in the Solar System are found: the asteroid belt between Mars and Jupiter, and the Trojans, two groups of asteroids moving ahead of and following Jupiter in its orbit around the Sun.

Source: https://sci.esa.int/web/hubble/-/59582-asteroid-belt

potentially hazardous NEO threat detection and threat response. Detection of potentially hazardous NEO threats is the activity of detecting space objects and characterizing their orbits, trajectories, size, and composition.[3] Threat detection is accomplished by observing the sky with both ground-based and space-based telescopes. The largest NEOs, which would threaten the most catastrophic damage, are also the easiest ones to detect and the majority have already been detected, but the catalogue of smaller NEOs is far from complete. NASA also coordinates with the Minor Planet Center,[4] as well as with international partners at space agencies and observatories. Additionally, the International Asteroid Warning Network (IAWN) acts as a clearinghouse for new NEO discoveries.[5]

The second avenue of planetary defense deals with responding to impending threats from potentially hazardous NEOs. Once a NEO threat is found and predicted to come close to—or actually impact—the Earth with a certain degree of confidence, if there is sufficient lead time, action could be taken in space to divert the object. If diverting the object is not an option, actions could be taken on Earth to mitigate the effects of impact.

Space-based asteroid threat response requires international planning and coordination. The Space Mission Planning and Advisory Group (SMPAG) coordinates lines of communication and assessment of national capabilities for NEO threat response.[6] Like the IAWN, SMPAG is merely a coordinating body. Active mitigation measures would be implemented by the countries that participate in IAWN and SMPAG. Apart from the technical challenges of diverting NEOs to avoid terrestrial impact, significant legal questions remain regarding any NEO redirect activities, including those of duties to warn and liability risks. In the case of large asteroids predicted to strike imminently and where there is insufficient time to mount a redirect mission, the only viable option may be to use a nuclear explosive device, although the international legality of such an option has yet to be agreed upon because of current restrictions on the placement of nuclear weapons in orbit.

3 NASA Jet Propulsion Laboratory, "How a Speck of Light Becomes an Asteroid," June 30, 2017, https://www.jpl.nasa.gov/news/news.php?feature=6888.

4 International Astronomical Union, Minor Planet Center, last accessed March 5, 2025, https://www.minorplanetcenter.net/.

5 International Asteroid Warning Network (IAWN), last accessed March 5, 2025, http://iawn.net/.

6 European Space Agency, The Space Mission Planning Advisory Group (SMPAG), last accessed March 5, 2025, https://www.cosmos.esa.int/web/smpag/home.

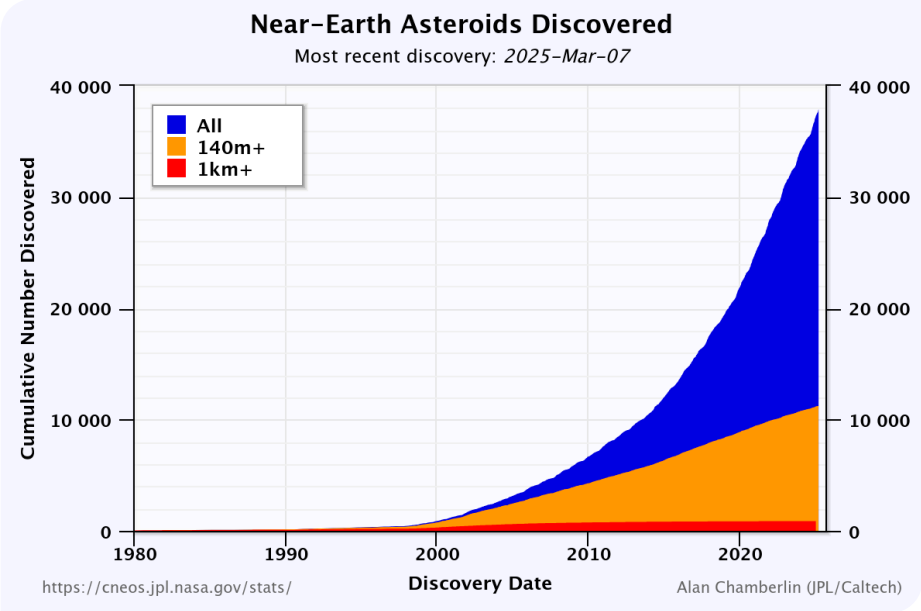

Figure 07 | Near-Earth Asteroids discovered as of March 7, 2025: 37,893 in total – a number which includes 11,232 objects larger than 140 meters in diameter and 873 objects larger than 1 km in diameter. [7]

Source: https://cneos.jpl.nasa.gov/stats/totals.html

On the national level, evacuation of large areas where an asteroid strike is predicted may be required—a massive undertaking that requires engagement by regional, state, and local governments with a predetermined plan of action and allocated responsibilities.[8] The 2018 *National Near-Earth Object Preparedness Strategy and Action Plan* outlines the coordination of roles and responsibilities of national agencies, including NASA and Federal Emergency Management Agency (FEMA) to strengthen and routinely exercise NEO impact emergency procedures and action protocols. These include protocols for coordinated communications and notifications regarding NEO threats and resulting emergency preparedness, response, and recovery protocols. These plans will need routine updating, and their incorporation into all-hazards response and recovery plans (e.g. Stafford Act, Post Katrina Emergency Management Reform Act). ●

7 NASA Jet Propulsion Laboratory Center for Near-Earth Object Studies, "Discover Statistics: Cumulative Totals", last accessed March 5, 2025, https://cneos.jpl.nasa.gov/stats/totals.html

8 White House, Interagency Working Group for Detecting and Mitigating the Impact of Earth-Bound Near-Earth Objects, National Near-Earth Object Preparedness Strategy and Action Plan (2018), https://www.nasa.gov/wp-content/uploads/2022/03/ostp-neo-strategy-action-plan-jun18.pdf

Policy Recommendations

→ NASA and its national partners should be given the assets and resources to complete the task assigned by Congress of the cataloging and orbital characterization of NEOs 140 meters and larger.

The larger NEOs have been detected, but many smaller yet still potentially threatening NEOs remain undetected. Finding these remaining NEOs will be harder and space-based telescopes appear to be the best path forward. NASA should be funded to mount these space-based NEO threat detection missions.

→ Clarify the existing rules—including rights and responsibilities—for any mission to divert or destroy an impending NEO strike, as well as establish the legality of using a nuclear explosive device for eliminating imminent NEO impact threats where no other options exist.

Legal issues of asteroid redirect missions are currently uncertain under existing international space law rules, and coordination and agreement on an international level should be sought. Additionally, the legality of the use of a nuclear explosive device for the largest and most urgent NEO threats should be agreed upon by countries before the Earth is faced with such a situation that requires a swift and coordinated international response. Proactive and results-oriented discussions at the international level, including through SMPAG and at the United Nations Committee on the Peaceful Uses of Outer Space, to address these questions is needed. The United States is uniquely placed to provide leadership in such discussions.

→ Achieve the goals of interagency, federal, state, and local preparedness outlined in the 2018 Near-Earth Object Preparedness Strategy and Action Plan.

These include strengthening and routinely exercising the communication of threats, and response and recovery efforts by agencies such as the Federal Emergency Management Agency and the Department of Homeland Security. Sufficient training and resources to these agencies is required to accomplish this preparedness task.

Contributors

Dr. Peter Martinez

Peter Martinez is the Executive Director of the Secure World Foundation (SWF). He has extensive experience in multilateral space diplomacy, space policy formulation, and space regulation. He also has extensive experience in capacity building in space science and technology and in workforce development.

Prior to joining SWF, from 2011 to 2018, Dr. Martinez chaired the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) Working Group on the Long-term Sustainability of Outer Space Activities that negotiated a set of international consensus guidelines to promote the safety and sustainability of space operations. In 2012 and 2013 he was South Africa's representative on the United Nations Group of Government Experts on transparency and confidence-building measures for space activities. From 2010 to 2015, he was the Chairman of the South African Council for Space Affairs, the national regulatory authority for space activities in South Africa. From 2014 to 2018, he was a Professor of Space Studies at the University of Cape Town. Before this, he served at various times as Acting Director and member of the Executive team of the South African Astronomical Observatory and the South African National Research Foundation.

Currently, he is a member of the International Academy of Astronautics, a Board member of the International Institute of Space Law, a Fellow of the Royal Astronomical Society, Member of the International Astronomical Union, and an Honorary Professor at the University of Cape Town. He has authored or co-authored 250 publications on topics in space policy, space sustainability, astronomy, space research, space law, and space policy.

Krystal Azelton

Krystal Azelton (née Wilson) is the Senior Director, Program Planning at the Secure World Foundation and has over 18 years of international and domestic space, public policy, and management experience.

Prior to joining SWF, Ms. Azelton was a consultant at Access Partnership, where she worked with international satellite service providers and other leading technology companies on policy issues related to spectrum management, emergency communications, telecommunications standards, orbital debris, and multilateral processes, including representing industry at the Inter-American Telecommunication Commission. She has also served as a project manager at the Tauri Group, a leading aerospace analytics firm, providing research, analysis, strategic planning, and regulatory assessment to government and commercial clients. She led and supported the production of NASA's strategic plans, audits, performance plans, budgets, and annual reports. Her work exposed her to the full range of NASA's Earth observation, human exploration, and aviation programs. In that role, she was also recognized as a key member of a data management team that received the NASA Group Achievement Award.

Ian Christensen

Ian Christensen is the Senior Director, Private Sector Programs at the Secure World Foundation. He has over 18 years of professional experience as a consultant and analyst focused on international and domestic commercial space, satellite, and aviation sectors.

He is responsible for leading SWF's engagement activities with the commercial space industry, where his activities focus on policy and governance topics in support of the development of private sector space capabilities: including topics such as space debris mitigation, norms of behavior for responsible space operations, and space situational awareness policy. Mr. Christensen was a member of the Hague International Space Resources Governance Working Group, where he chaired the Group's Socioeconomic Panel. He also served as a member of the Secretariat for the Consortium for Execution of Rendezvous and Servicing Operations (CONFERS), an industry group developing best practices and standards for commercial satellite servicing. Mr. Christensen also is currently a member of the Global Expert Group on Sustainable Lunar Activities (GEGSLA). He currently serves as a member of the Federal Communications Commission World Radiocommunication Conference Advisory Committee for WRC-27.

Prior to joining SWF, Mr. Christensen worked at leading space sector consulting firms Futron Corporation and Avascent. Prior to Futron, Mr. Christensen was a research assistant at the Space Policy Institute at George Washington University; a Policy Fellow at the National Academies of Science Committee on Science, Engineering and Public Policy; and a research assistant at the University of Nebraska Public Policy Center. Mr. Christensen holds a Master of Arts (M.A.) in international science and technology policy, focusing on space policy from the George Washington University Elliott School for International Affairs. He holds dual Bachelor's of Science (B.S.) degrees in political science and biochemistry from the University of Nebraska-Lincoln. He also completed the International Space University (ISU) 2007 Space Studies Program in Beijing, China.

Christopher Johnson

Chris Johnson is the Space Law Advisor for the Secure World Foundation, a Professor of Law (Adjunct) at the Georgetown University Law Center (where he co-teaches the spring Space Law Seminar), and a Faculty Member at the International Space University. A member of the International Institute of Space Law (IISL), Mr. Johnson has written widely on space law and policy issues and represents the Secure World Foundation at the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS).

Mr. Johnson holds a Bachelor of Arts degree from Michigan State University, a Juris Doctor from New York Law School, and an Advanced Masters in Law (LLM) in Air and Space Law from Leiden University's International Institute of Air and Space Law. He also has professional certificates from New York University's School of Continuing and Professional Studies, the Oxford Institute of Legal Practice, the European Centre for Space Law, the Hague Academy of International Law, and the International Institute of Humanitarian Law.

Prior to joining SWF, Mr. Johnson worked as an attorney in New York City and entered the space field in 2010 as an intern at the United Nations Office for Outer Space Affairs in Vienna, Austria, during the 53rd COPUOS. He has also served as an intern in the Office of International and Interagency Relations at NASA Headquarters in Washington, D.C., and as a legal stagiaire in the International Law and EU Legal Affairs division at the European Space Agency's Legal Department at ESA Headquarters in Paris, France. As a member of the Space Generation Advisory Council, Mr. Johnson co-founded the Space Law and Policy Project Group in 2012.

Victoria Samson

Victoria Samson is the Chief Director, Space Security and Stability for the Secure World Foundation and has over 25 years of experience in military space and security issues.

Before joining SWF, Ms. Samson served as a Senior Analyst for the Center for Defense Information (CDI), where she leveraged her expertise in missile defense, nuclear reductions, and space security issues to conduct in-depth analysis and media commentary. Before her time at CDI, Ms. Samson was the Senior Policy Associate at the Coalition to Reduce Nuclear Dangers, a consortium of arms control groups in the Washington, D.C. area, where she worked with Congressional staffers, members of the media, embassy officials, citizens, and think tanks on issues surrounding dealing with national missile defense and nuclear weapons reductions. Before that, she was a researcher at Riverside Research Institute, where she worked on war-gaming scenarios for the Missile Defense Agency's Directorate of Intelligence.

Known throughout the space and security arena as a thought leader on policy and budgetary issues, Ms. Samson is often interviewed by multinational media outlets, including The New York Times, Space News, The BBC, and NPR. She is also a prolific author of numerous op-eds, analytical pieces, journal articles, and updates on space security matters. She is also the head of the International Astronautical Federation's task force on security and a member of the Space Security Working Group of the National Academies of Sciences, Engineering, and Medicine's Committee on International Security and Arms Control.

Emily Kunasek

Emily Kunasek serves as a Program Associate at the Secure World Foundation, focusing on technology and security issues within the space domain. With a strong background as an intelligence analyst, she previously worked at Rhombus Power, a national security AI company, where she developed AI solutions for civil and military applications and conducted in-depth analyses of space-related challenges. Her prior experience includes interning at the National Security Archive and contributing to the Cyber Vault Project by archiving and analyzing declassified government documents concerning cybersecurity and emerging technologies.

Ms. Kunasek is also a peer reviewer for the Georgetown Security Studies Review, a prominent student-run journal in the United States, enriching her engagement with contemporary security studies. She holds a Bachelor of Arts (B.A.) degree in Economics and International Affairs from the George Washington University Elliott School of International Affairs and is currently pursuing a Master of Arts (M.A.) in Security Studies at Georgetown University's Walsh School of Foreign Service. Her academic endeavors included an exchange at Victoria University of Wellington, New Zealand, focusing on international politics, further shaping her analytical and policy skills in the global arena.

List of Acronyms

ADR
Active debris removal

ASAT
Anti-satellite

ATLAC
Action Team on Lunar Activities Coordination

CD
Conference on Disarmament

CME
Coronal mass ejection

CMSEO
China Manned Space Engineering Office

COPUOS
Committee on the Peaceful Uses of Outer Space

CRD2
Commercial Removal of Debris Demonstration

DA-ASAT
Direct-ascent anti-satellite

DOC
Department of Commerce

EMP
Electromagnetic pulse

EOE
Earth Observations Enterprise

EU SST
European Union Space Surveillance and Tracking

FAA
Federal Aviation Administration

FCC
Federal Communications Commission

GOES
Geostationary Operational Environmental Satellite

IADC
Inter-Agency Orbital Debris Coordination

IAWN
International Asteroid Warning Network

ILRS
International Lunar Research Station

ITU
International Telecommunication Union

ISAM
In-space servicing, assembly, and manufacturing

ISR
Intelligence, surveillance, and reconnaissance

ISS
International Space Station

LEO
Low Earth orbit

NASA
National Aeronautics and Space Administration

NEO
Near-Earth object

NGA
National Geospatial-Intelligence Agency

NOAA
National Oceanic and Atmospheric Administration

NSpC
National Space Council

NSTC
National Science and Technology Council

ODMSP
Orbital Debris Mitigation Standard Practices

OSC
Office of Space Commerce

OSTP
Office of Science and Technology Policy

PAROS
Prevention of an arms race in outer space

PNT
Position, navigation and timing

PROSWIFT
Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow

SMPAG
Space Mission Planning and Advisory Group

SPD
Space Policy Directive

SSA
Space situational awareness

STC
Space Traffic Coordination

SWAG
Space Weather Advisory Group

SWORM
Space Weather Operations, Research, and Mitigation

TRL
Technology readiness level

TraCSS
Traffic Coordination System for Space

USGS
U.S. Geological Survey

USSF
U.S. Space Force

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